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VOL. 33. Ser. A. Part 7. pp. 193–232. JULY, 1945.

THE REVIEW OF APPLIED ENTOMOLOGY.

SERIES A: AGRICULTURAL.

ISSUED BY THE IMPERIAL INSTITUTE OF ENTOMOLOGY.

LONDON:
THE IMPERIAL INSTITUTE OF ENTOMOLOGY,
41, QUEEN'S GATE, S.W.7.

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SEVERIN (H. C.). **The Grasshopper Mite *Eutrombidium trigonum* (Hermann), an important Enemy of Grasshoppers.**—*Tech. Bull. S. Dak. agric. Exp. Sta.* no. 3, 36 pp., 19 figs., 13 refs. Brookings, S. Dak., 1944.

The literature on the nomenclature of the mite that is common on grasshoppers in the United States is reviewed, and all stages are described. It is concluded that its correct name is *Eutrombidium trigonum*, Hermann, of which *Trombidium sericeum*, Say, and *E.* (*T.*) *locustarum*, Walsh, are considered synonyms. It is found each year in many parts of South Dakota, and though it has not been observed to control a severe grasshopper outbreak there, it has done so in other parts of the United States. Its distribution does not appear to be greatly influenced even by large variations in rainfall or in soil moisture, though its numbers are reduced by flooding for several weeks and by prolonged drought.

The larvae of this mite are parasitic on grasshoppers, and the nymphs and adults feed on grasshopper eggs. A study of its life-cycle showed that it has one complete generation, and a partial second, in the year in South Dakota. Nymphs and adults overwinter in the soil and then come to the surface and crawl about in search of grasshopper egg-masses. When the mite finds an egg-mass, it burrows into it and feeds on the contents of several eggs. An engorged female begins to oviposit 5–17 days after the first feed and lays an average of 4,700 eggs over several weeks in chambers in the soil. At 65–75°F., the eggs hatch in 15–28 days. The larvae come to the surface of the soil, attach themselves to adult or nymphal grasshoppers and feed on their blood. All the species of grasshoppers that occur in South Dakota are subject to attack. The larva drops from the grasshopper after 8–14 days, burrows into the soil and, within three days, transforms into a pre-nymphal pupa. After 7–18 days, the nymph emerges from the pupa and feeds on grasshopper eggs for 13–50 days ; it then forms a chamber in the soil, and transforms to a pre-imaginal pupa. The adult emerges 9–18 days later. The adults feed preferably on the eggs of grasshoppers, though in the laboratory they also fed on earthworms and dung. Most of the mites that become adult during the summer or early autumn do not lay eggs until after hibernation.

As many as 175 larvae of the mite have been found on a single grasshopper, but they do not prevent the nymphs from developing into apparently normal adults, and have little effect on their host except to weaken it. A moderate infestation does not seem to shorten the life of adult grasshoppers or affect reproduction, though a severe infestation on the wings and wing-bases may interfere seriously with flight. When the mites feed on grasshopper eggs, the liquid contents may be drained to such an extent that the eggs collapse and die, but eggs less seriously damaged recover and give rise to apparently normal grasshopper nymphs. A single nymphal mite may attack up to 14 grasshopper eggs, but only a fraction of these is actually destroyed.

Amendment No. 5 to Rules and Regulations governing the Importation of Cotton and Cotton Wrappings into the United States.—*B.E.P.Q.—Cotton Reg. 6, Amdt. 5* 2 pp. [Washington, D.C., U.S. Dep. Agric.] 1945.

This amendment to existing Rules and Regulations [*R.A.E.*, A **11** 259 ; **13** 180] applies to cotton imported into the United States for manufacture into cellulose and authorises the importation without disinfection through maritime ports of cotton linters and hull fibres in bales compressed to a density of at least 35 lb. per cu. ft. provided that they are promptly utilised, since this involves no appreciable risk of the introduction of pests. The amendment applies only to bales imported in sufficiently large quantities, and the collection and disposal of bale covers, wastage and débris and the cleaning of the waggons used for transport are to be carried out in accordance with the requirements of authorised inspectors.

(489) Wt. P6/3762 8/45 S.E.R. Ltd., Gp. 432 [A] A

SCHNEIDER-ORELLI (O.). **Zur Schädigung der Weisstanne durch Trieb- und Rindenläuse** (*Dreyfusia*). [On Damage to Silver Fir by *Chermes* spp.]—*Schweiz. Z. Forstwes.* 1944 no. 1 repr. 11 pp., 2 pls., 10 refs. Berne, 1944.

The two species of *Chermes* (*Dreyfusia*) that are injurious to silver fir (*Abies*) in Switzerland are *C. nordmannianae*, Eckstein (*nüsslini*, Börner) and *C. piceae*, Ratz.; *C. prelli*, Grosmann, has also been recorded there, but only on the introduced *A. nordmanniana* and *A. cephalonica*. Much of the information in this paper on the history and bionomics of *C. nordmannianae* has been noticed from earlier sources [*R.A.E.*, A **17** 639; **25** 659]. *C. piceae* is of less importance, and its life-cycle in Switzerland is less well-known. Sistentes occur in large numbers, but progredientes are rare, and winged sexuparae have not been reared from them. It therefore appears that this species, like *C. nordmannianae*, can persist on *Abies* in the absence of its primary food-plant, which is also probably some species of spruce [*cf.* **24** 671]. It is limited to the stems, mostly those of trees more than 30 years old, and, in exceptionally dry summers, causes cracking of the bark, loss of resin and sometimes yellowing of the crown. Microscopic examination has given no evidence that the curling of needles on spring-shoots and the stunted growth or withering of the crown shoots on trees up to 25 years of age are caused by this species, and such injury can safely be attributed to *C. nordmannianae*.

C. nordmannianae and *C. piceae* were not found in association until 1943, when they were observed together on the stems of old trees in two districts. They had often previously been found in the same stand in these districts, but on different trees. In 1942, both were found on a silver fir 40 years of age, *C. piceae* on the stem and *C. nordmannianae* on isolated parts of the branches. In view of the difficulty of recognising that an infestation is mixed, the microscopic morphological characters distinguishing first-instar sistentes of the two species are described.

C. nordmannianae occurs in many parts of Switzerland, but its local distribution is not fully known; it has been found at altitudes greater than 3,300 ft. The occurrence of isolated colonies separated by wide gaps indicates dispersion by wind or the agency of man or animals. In view of the risk of introduction of infested nursery stock to replace trees that have died, imported stock should not be employed and all local stock should be thoroughly treated with an insecticide before delivery. Experience since 1929 had not fully confirmed the theory that shade protects the trees from damage by *C. nordmannianae* [**17** 640]. It appears that the supposed limitations imposed by altitude and shade have been partly eliminated in recent years by an increase in the aggressiveness of the Aphid. Outbreaks are cyclical in nature, however; in the district of Vorderarni, infestation reached a maximum in 1939 [*cf.* **28** 55] and then decreased until 1943, when it again began to increase. Evidence that warm, dry summers such as that of 1942 favour the increase of *Chermes* is provided by the fact that infestation by *C. piceae* also reached considerable proportions. Microclimatic factors sometimes assist in reducing the high populations, and natural enemies [**20** 55; **28** 55] may also play an important part. Mortality among silver firs cannot always be attributed to *Chermes*. Of three trees examined, all exhibiting symptoms of attack, it was not possible to determine whether excessive exposure to sun and lack of soil moisture had not also contributed in the case of two, and in the third attack by fungi had provided conditions that had resulted in infestation by bark-beetles, Longicorns and *Sirex*. The destruction of young infested trees is considered to be the best method of control [*cf.* **17** 640]; if individual trees only are involved, the gap is soon filled, but if the removal of a group leaves a larger gap, infestation sometimes develops on the exposed trees round the edge, preventing regeneration. Individual resistant trees have been found in heavily infested areas, and the

felling of individual trees can sometimes be avoided by applications of sprays or dusts [*cf.* **27** 517].

Box (H. E.). **The Cacao Pest Situation in West Africa and the Cameroons, with special Reference to *Sahlbergella singularis* Hagl., and *S. theobroma* Dist. (Hemiptera : Capsidae). Report upon a Visit to French Togo, Dahomey, Nigeria and the Cameroons during the Dry Season, December, 1943 to March, 1944.**—*Tech. Bull. W. Afr. Cacao Res. Inst.* no. 1, [3+] 69 pp., 1 map [lacking], 52 refs., multigraph. Tafo, 1944.

In view of the serious consequences of infestation by *Sahlbergella singularis*, Hagl., and *Distantiella* (*S.*) *theobroma*, Dist., on cacao in the Gold Coast [*R.A.E.*, A **32** 287], a survey was made between December 1943 and March 1944 in French Togo, Dahomey, Nigeria and the Cameroons to assess the incidence of these and related species on cacao and indigenous food-plants. Details of the conditions affecting the cultivation of cacao and the results of the survey comprise a large part of this report, but it also includes reviews of the development of production of cacao in Africa, history of its Capsid pests there and the factors that have favoured their transfer from wild food-plants to it, and brief accounts of the investigations on the nature and control of the swollen-shoot virus disease of cacao in the Gold Coast that led to the realisation of the Capsid problem and of the findings of an international conference held in 1943, as a result of which the present survey was undertaken.

The following is based on the author's summary of his observations. *Sahlbergella singularis* was injurious in varying degrees throughout the whole area visited, except on isolated cacao in south-eastern Dahomey and in several widely-scattered localities in southern Nigeria, and has therefore probably developed from several localised foci. In the Gold Coast, Nigeria and the French Cameroons, damage appears in general to be more frequent and severe in the damp forest zone than in the drier deciduous forests and savannah land, though it may sometimes be as serious in the latter as in the former. Other factors besides rainfall and humidity appear to influence incidence, since this is low at a place in the British Cameroons stated to be the wettest in Africa. This Capsid is not as yet of major importance in the areas of deciduous forest bordering savannah examined in Nigeria, the French Cameroons and French Togoland, nor in similar areas in British Togoland and the Gold Coast. In the equatorial forest, it is present on cacao everywhere and of extreme importance in many places ; it limits the cultivation of cacao over large areas in two provinces in Nigeria and is well established in the relatively recent cacao farms in the central zone of the French Cameroons, where it was observed on cacao less than three years of age [*cf.* **19** 732]. Some evidence was obtained that damage is less severe in plantations than on native farms. *Cola togoensis*, an alternative food-plant in the Gold Coast, occurred at most places in the cacao-growing districts of western Nigeria, but was not found in primitive plant associations, and may therefore have become infested from cacao. Some damage by *S. singularis* was found on it, but none in a district in which it was abundant and the Capsid was attacking cacao. East of the Niger, it is replaced by a closely-related species of *Cola*, which also occurred in the Cameroons, but did not appear to be attacked. No predators of *S. singularis* were found, and in an experiment in Nigeria on a cacao farm bordered by *Citrus* trees harbouring large numbers of the predacious ant, *Oecophylla smaragdina longinoda*, Latr., in which all the trees were interconnected so that the ants could pass from one to another over the whole area, damage by *S. singularis* was extremely severe in December 1943 and February 1944, although the ants were numerous on the connecting bridges [*cf.* **33** 65]. The percentages of *Sahlbergella* parasitised by *Euphorus sahlbergellae*, Wlkn., and (in brackets) of larvae of *Euphorus* parasitised by *Mesochorus melanothorax*,

Wlkn., were 2·8–19·5 (0–23·5) in Nigeria and 7·9 (not ascertained) and 16·8 (18·7) at two places in the British Cameroons, as compared with 33·5 (31) in the course of large-scale dissections at Tafo (Gold Coast) over the corresponding period in 1942–43.

The known range of *Distantiella theobroma* was extended as a result of the survey to include eastern Nigeria, the British Cameroons, and the northern and central parts of the French Cameroons, in none of which did it occur on cacao. The amount of damage due to it can be judged only on cacao less than four or five years of age, where care is required to distinguish it from that due to *S. singularis*, but both adults and nymphs may feed on the pods of older trees at certain seasons. Severe damage was observed only once on cacao in dry regions bordering savannah in western Nigeria. This Capsid has not been recorded from the main cacao-growing areas of British and French Togoland, which are in country transitional between dry deciduous forests and orchard savannah, but it was established in young trees in evergreen forests on the central mountain range. Severe damage occurred in newly-established farms in western Nigeria, but not in densely forested regions in the south. It is thought that *D. theobroma* has only recently become a pest of young cacao. *Ceiba pentandra*, the only wild food-plant known with certainty, was attacked in widely-separated localities in Nigeria and the British and French Cameroons, often when growing by young cacao that was free from infestation. Some injury to *Citrus* was observed in Nigeria. No specific predators and no parasites were found.

Bryocoropsis laticollis, Schum., which occurs in the Gold Coast [**32** 287] and Spanish Guinea, was not found in any of the places surveyed, but investigation in the wet season, when pods are more abundant, might lead to its discovery. It is of interest as it is a host of *E. sahlbergellae* [**32** 288] and may be attacked by other parasites.

Helopeltis bergrothi, Reut., was found in small numbers on cacao in Nigeria and the British Cameroons, and is recorded from the latter for the first time. Nymphs of this Capsid were observed on *Leea guineensis* in Nigeria, but it did not occur on *Solanum verbascifolium*, even at the place where it was previously recorded on this plant [**29** 516]. *Mareya spicata*, on which it is found in the Gold Coast, was not observed in Nigeria or the Cameroons. A few nymphs of the undetermined species of *Helopeltis* common on cacao pods in the Gold Coast [**32** 287] were collected on cacao pods in the British Cameroons, and this species was found breeding in numbers on pods in the central zone of the French Cameroons.

The seven other Bryocorine Capsids recorded were not found on cacao, but *Odoniella rubra*, Reut., was collected in a cacao farm in Nigeria as well as in secondary forest in Nigeria and on *Piper guineense* in French Togoland, and nymphs of *Pachypeltis* sp., occurred on *Combretum* sp. on the edge of cacao plantations in the British Cameroons. Nymphs and adults of *Lycidocoris mimeticus*, Reut. & Popp., slightly injured the leaves and terminal shoots of coffee (*Coffea arabica*) in French Togoland.

Of the mealybugs that are known to be vectors of some strains of the swollen-shoot virus disease of cacao in the Gold Coast [**32** 246], *Ferrisia virgata*, Ckll., was taken on *Xanthosoma* and *Leucaena glauca* in Nigeria, coffee (*Coffea robusta*) in the French Cameroons, and *Ochroma lagopus* and *Macaranga* sp. in the British Cameroons, and *Pseudococcus exitiabilis*, Laing, on *Ceiba pentandra* in British Togoland, *Sterculia tomentosa* in French Togoland, and pods of cacao and the foliage of *Cola* spp. in Dahomey. A mealybug superficially identical with *P. citri*, Risso, was fairly common, though never abundant, on cacao pods throughout the area, and two species closely allied to *P. exitiabilis* were found on various plants in Nigeria, a single example of one of them being on a cacao shoot.

MARTIN (H.), STRINGER (A.) & WAIN (R. L.). **The qualitative Examination of insecticidal Properties. Progress Report—1943.**—*Rep. agric. Res. Sta. Bristol 1943* pp. 62–76, 1 fldg. table, 22 refs. Bath [1944].

This is the first of a series of reports on the development and results of rapid routine methods for the laboratory examination of the insecticidal action as fumigants, stomach poisons, contact poisons and deterrents of insecticides already known and new synthetic compounds. As the purpose of the tests was the selection of compounds for field trial as substitutes for imported insecticides, no special attempts were made at quantitative comparison, though techniques ultimately capable of rigid standardisation were selected when possible. Details are given of a method of testing stomach-poison and repellent effects on cabbage caterpillars by means of sandwiches 18 mm. in diameter and composed of two disks of young unwrinkled cabbage leaves, one treated with 0·02 ml. of a solution of a known concentration of insecticide in acetone and the other smeared with lanolin, both on the upper surface, before they were pressed together. Contact effect was tested either by rotating individuals of resistant species such as earwigs (*Forficula*) or woodlice, in beakers with small amounts of a dust of ground gypsum and amorphous silica (95 : 5) on which the chemical to be tested had been deposited from acetone solution, transferring them to dishes lined with filter paper and removing excess dust from the filter paper by suction, or by pumping a known quantity of dust directly on to those of more susceptible species (cabbage caterpillars) and transferring them with fresh food to dishes covered with muslin.

In tests of rotenone as a stomach poison, solutions containing 0·5 and 5 per cent. crystalline rotenone had no effect on *Mamestra brassicae*, L., but the higher concentration gave practically complete mortality of *Pieris brassicae*, L., and *P. rapae*, L. ; a concentration of 10 per cent. gave complete mortality of both *Mamestra* and *P. brassicae*. Solutions of 33·3 and 3·33 per cent. derris resins (25 per cent. rotenone) had little effect on *Mamestra*, but were much more toxic to *P. rapae*. Control disks treated with acetone caused no mortality and were much more readily eaten, indicating a deterrent effect of rotenone. Rotenone showed little or no effect as a contact poison in tests in which ground *Loncho-carpus* root (5 per cent. rotenone) was used at concentrations of up to 67 per cent. against *Mamestra*, earwigs and woodlice and up to 25 per cent. against *P. rapae* and *P. brassicae*, and crystalline rotenone at 0·5 and 1 per cent. against *Mamestra*.

In tests of polychlorethane derivatives as stomach and contact poisons, αα-bis (parachlorphenyl) βββ-trichlorethane [DDT] showed outstanding toxicity. It gave practically complete mortality as a stomach poison at the lowest concentrations tested (0·5 per cent. against *Mamestra* and *P. brassicae* and 5 per cent. against *P. rapae*) and was highly toxic at similar or even lower concentrations when tested as a contact poison against *Mamestra*, *Pieris* spp., earwigs and woodlice. Its insecticidal properties were apparently specific to its particular molecule ; the analogous compounds, αα-bis (parachlorphenyl) ββ-dichlorethylene and 4, 4′-dichlorbenzophenone, which were tested only as contact poisons, were much less toxic. No estimate of the median lethal dosage of DDT was possible as even *Mamestra* was killed by doses of the order of 0·01 mg. per larva, and the contact toxicity was similar. As stomach poisons at a concentration of 5 per cent., αα-diphenyl βββ-trichlorethane showed only slight toxicity to *Mamestra* and *P. rapae*, and αα-bis (hydroxy-phenyl) βββ-trichlorethane and the corresponding diacetate were ineffective against *Mamestra*, though the latter gave a low kill of *P. brassicae* ; as contact poisons at the same concentrations, the first compound was ineffective against earwigs and woodlice, and the other two showed only slight toxicity to these and *Mamestra*.

Few of the simpler derivatives of benzene and naphthalene have been found to equal the potency of 3, 5-dinitro-ortho-cresol [numbered with CH_3 as 1], but under certain conditions this compound is readily reduced, and it is necessary to know whether the reduction products possess insecticidal properties; the general effect of the substitution of amino groups for nitro groups in the simpler derivatives was accordingly examined. At concentrations of 5 per cent., dinitrocresol gave complete mortality of earwigs and woodlice when used as a contact poison, but low mortality of *Mamestra* and *P. rapae* as a stomach poison, owing to its deterrent effect. The reduction of one nitro group gave 3-amino-5-nitro-o-cresol, which showed no action as a contact or stomach poison or deterrent. The properties of 3, 5-dinitro-o-tolyl acetate as a contact insecticide were similar to those of dinitro-cresol. Meta-dinitrobenzene showed contact properties against earwigs and woodlice, but the substitution of one nitro group by the amino group to give m-nitraniline resulted in a loss of toxicity. Para-nitraniline was also considered ineffective, but the substitution of chlorine for the amino group gave p-chlornitrobenzene, which showed high contact toxicity but no effect as a stomach poison. Several of the simpler aromatic nitriles that were included in the tests showed no promise as contact insecticides, though p-tolyl cyanide rapidly produced temporary paralysis of both earwigs and woodlice.

Dodecyl thiocyanate and butyl carbitol thiocyanate were deficient in stomach-poison properties, and the related dodecyl nitrile and other higher fatty nitriles, tested in mixtures of dodecyl and tetradecyl nitriles (90 : 10) and of octadecyl, octadecadienyl and hexadecyl nitriles (60 : 25 : 15), were non-toxic, but showed some degree of deterrent action at high concentrations.

Of a few miscellaneous compounds tested as stomach poisons, the mono-sulphide and disulphide of tetramethylthiuram did not produce toxic symptoms in *M. brassicae*; pure phenothiazine was practically non-toxic to *M. brassicae*, but affected *P. brassicae* after negligible feeding; and salicylaldehyde, excreted by larvae of *Phyllodecta vitellinae*, L., and a condensation product of isophorone, sold under the trade name of Crystox, were not toxic or repellent to *M. brassicae* and *Pieris rapae*.

MILES (H. W.). **The Wireworm Survey in the Western Province, 1942–3.**—*Rep. agric. Res. Sta. Bristol 1943* pp. 111–118, 2 refs. Bath [1944].

The following is substantially the author's summary. Wireworm survey work in five counties of western England in 1942–43 was conducted on a county basis, and population estimates were made on grassland and on new and established arable land. Although the selection of fields for examination was biased by the needs of advisory work, it was apparent that the level of wireworm population varied in the different counties. In Herefordshire, over 60 per cent. of the grass fields examined had high populations (over 600,000 per acre) and less than 20 per cent. had low ones (under 300,000 per acre); in Somerset less than 10 per cent. of the fields had high populations and over 70 per cent. low ones; and in Wiltshire, Worcestershire and Gloucestershire, the fields were more evenly distributed among the high, medium and low population groups.

Crop failure was most frequent in fields with high wireworm populations, but a comparison of the numbers of crop failures in the various counties showed that wireworm population was not the only factor affecting yields. A comparison of crop results from new arable fields carrying first, second and third crops of cereals indicated that risks of crop failure from wireworm attack were not greater in the second and third year after grass than in the first year [*cf. R.A.E.*, A **31** 25]. Observations on wireworm populations in established arable land indicated that in land under frequent cultivation the wireworm population was so low as to be almost negligible [*cf.* **28** 157]. When short periods of cropping with cereals were separated by leys of 2–5 years' duration, as in parts of

Herefordshire, the level of wireworm population in old arable land was high and constituted a risk to the crops. The decline in wireworm population when grassland was cultivated was demonstrated by a comparison of populations in land at different stages between grass and established arable.

MILES (H. W.). **Frit Fly on Oats in the West of England.**—*Rep. agric. Res. Sta. Bristol 1943* pp. 119–123, 1 pl., 3 refs. Bath [1944].

The frit fly [*Oscinella frit*, L.] was widespread on cereal crops, particularly oats, in Herefordshire, Worcestershire, Gloucestershire, Wiltshire and Somerset in 1943. This Chloropid attacks cereals on both new and established arable land, and has three generations a year. The adults are abundant in the harvest fields on sunny days, and after harvest they scatter and deposit eggs about the shoots of grasses and possibly in the seedlings of winter cereals that have been sown early. The larvae bore into the base of the central shoots and may destroy several seedlings before pupating. These or similar larvae are present in winter cereals in most seasons, but if injury is well distributed and fertility satisfactory, there is some compensatory growth in the remaining plants ; bare patches can be resown in spring. Adults of the overwintered generation emerge during April and May and oviposit on newly sown oats. The larvae kill some seedlings and feed in the developing tillers, over 20 per cent. of which are infested in some seasons [*cf. R.A.E.*, A **19** 51]. The crop may not be affected if the seed has been thickly sown and the plants make rapid growth, but during severe attacks in areas of low fertility, bare patches appear when it is too late for sowing with another cereal, and the establishment of weeds may impair the condition of the land in the following season. Moreover, the loss of tillers in late spring may cause a marked reduction in yield, since late tillers mature in time for harvest only under conditions of high fertility and rapid growth. These larvae give rise to adults in summer, which deposit eggs about the young ears. The larvae feed on the developing grain, and this attack has a direct effect on the yield ; observations in various parts of the country have indicated that such loss is widespread.

Examination of random samples of grain from crops of oats, including many of the most popular varieties, sown from September to May in the five counties showed an estimated average loss of weight of 12·6 per cent. due to *O. frit*. The loss was 8·5, 16·4 and 21·6 per cent. in crops sown before, during and after the three weeks ending in mid-April [*cf.* **19** 52]. Evidence regarding the effect of the preceding crop was not conclusive, since the average loss for 53 fields in which oats followed roots did not differ significantly from that in 76 in which they followed cereals or grass. Differences in loss between varieties were not significant, but the six most popular varieties showed a heavy loss in yield owing to attack on the grain. It is concluded that, to prevent serious loss, it is essential to secure early establishment and tillering of the seedlings, and that this is assisted by sowing healthy seed generously in a firm and fertile soil.

BODENHEIMER (F. S.). **Studies on the Ecology and Control of the Moroccan Locust** (*Dociostaurus maroccanus*) **in Iraq. I. Results of a Mission of the Iraq Department of Agriculture to N. Iraq in Spring 1943.**—*Bull. Iraq Dir.-Gen. Agric.* no. 29, 121 pp., 21 pls., 16 figs., 24 refs. Bagdad, 1944.

This is a report on the results of field observations on *Dociostaurus maroccanus*, Thnb., carried out in April–June 1943 in an area about 29 miles west of Mosul, northern Iraq. A short account is given of the evidence found in Assyrian texts and figures, of the importance of locusts in Iraq in the earliest historical times.

The hatching of the eggs was delayed in 1943, and this is attributed to the high rainfall in March, since eggs in soil kept saturated in the laboratory hatched 25 days later than those in soil that was originally wet but was allowed to become

dry. Hatching in the field continued from about 3rd to 28th April, but the hoppers that hatched late apparently developed more quickly than the others, since practically all reached the fifth stage at about the same time. Most hoppers reached this stage about 33 days after hatching, whereas the period required after a normal hatching date is 40–43 days. Local movements of hopper bands and adult swarms within the area under observation are described, and some examples of full-day observations on their behaviour are given. Feeding by young hoppers was restricted to ground level and their general activity was low ; only slight movement at noon towards shadier spots was observed, while sun-basking groups were formed in the morning and afternoon (7–11 a.m. and 3–6 p.m.) Hoppers in the second and third stages had two definite peak periods of feeding, the first between 7.30 and 10 a.m. and the second between 3 and 5 p.m. The morning peak became more definite in a band of third- and fourth-stage hoppers, but no major activity occurred during the rest of the day. Hoppers of the fifth stage and young adults behaved like hoppers of the second stage. During the oviposition period, the peak of feeding by adults was between 11 a.m. and 1.30 p.m.

Estimates of the population density, made by counting the hoppers and adults attracted to bait pans from representative small areas, though unsatisfactory for the later hopper stages, showed that density increased up to the third and fourth stages, after which there were sharp decreases for the fifth and adult stages. This suggests that hoppers begin to disperse after the fourth stage. Counts of the numbers of hoppers in small sample areas indicated that one moderate-sized band of second-stage hoppers extending over nearly 720 sq. yds. contained over 3½ million hoppers, and a fifth-stage band in migration, with a front of about 1·4 miles and a depth of 66 yds., which was not the largest seen, contained 18 million. In another hopper band, of which over half were killed by poison bait, up to 100 million dead hoppers were seen over about 370 acres. A flying swarm was estimated to contain nearly 14 million locusts. Estimates suggested that the sex-ratio at hatching is approximately 50 : 50 but males appeared to hatch 1–2 days earlier than females. The sex-ratio among adults was variable, both in solitary and in gregarious locusts, but the average approached 50 : 50.

The vegetation and soils of oviposition sites are described ; the character of the vegetation was similar to that already recorded [*R.A.E.*, A **21** 627 ; **23** 743.] A black lichen (*Lecidea* sp.) covering the ground on otherwise bare patches appeared to cause concentrations of hoppers in the early stages. A strict correlation between mass occurrence of *D. maroccanus* and dense growth of *Poa bulbosa* was observed, but the reason was obscure except that young hoppers appear to be attracted to the patches of *Poa*, possibly because they are better insolated, and leaves of this grass constitute almost their sole food during the first few days after hatching. At the end of the first stage, they begin to feed on other plants, such as *Carex* and *Erodium*.

Although the steppe was very green in the spring of 1943, hopper bands were formed and began to migrate as usual, which suggested that the lack of food is not a primary stimulus to locust migrations. As the vegetation dried up, its braking effect decreased, and migration accelerated. The movements of hoppers and adults in the field were not related to the position of the sun or the direction of the wind. Dark clumps of plants attracted moving hoppers, while a white stone did not. Exposed pans of water activated adult locusts in the neighbourhood, individuals becoming agitated and coming to the water from a distance of as much as 22 yards. Over 90 per cent. of all locusts came against the wind. Salt water proved as attractive as fresh, but the locusts left after tasting it, whereas they drank the fresh water. Low-flying locusts were observed to leave a swarm and settle when passing over pans of water or pools in ravines. Other points in the sense physiology of locusts in relation to the daily routine in their behaviour are discussed [*cf.* **28** 28]. Oviposition occurred most commonly

between 8 and 11 a.m. The average number of eggs per egg-pod was 22 in the solitary phase and 30 in the gregarious. Observations indicated that gregarious adults oviposit at least two or three times and possibly four or five times, undertaking flights between the ovipositions.

In starvation experiments mortality of hoppers in the third or later stages and of adult males was heaviest on the fourth day and complete after eight days, and that of females was heaviest on the ninth day and complete after 12 days. Natural enemies [*cf.* **19** 84] are discussed and considered of no practical importance, though the percentage of egg-pods infested by larvae of the Clerid, *Trichodes laminatus*, Chevr., was occasionally as high as 50.

Phase characters in *D. maroccanus* established by previous authors [**22** 702; **30** 616] are confirmed; an additional character is the colour of the hind tibiae (red in ph. *solitaria* and grey in ph. *gregaria*). It is stressed, however, that neither biometrical nor chromatic characters are absolute, and the decisive criterion is field behaviour. The average numbers of eggs laid by solitary and gregarious females are estimated to be 30 and about 120, respectively. The behaviour of gregarious hoppers moving in a band differed from that of solitary ones by more intensive jumping and feeding. Solitary adults were never observed to climb plants, whereas the gregarious ones did so regularly. The existing theories of phase transformation in *D. maroccanus* and other locusts, and of the origin of outbreaks [**20** 548; **21** 627; **28** 28; etc.] are reviewed. In *D. maroccanus*, the first stages, passed within an outbreak area, agree with the general scheme, but after the first swarms have emigrated, dense oviposition sites are established in the invasion zone and a rapid increase follows as a result of the higher vitality and fertility of the gregarious phase.

Field experiments on control showed that bran moistened with water was a more attractive bait than bran moistened with crude oil and that the addition of date molasses to the moist bran did not increase its attractiveness. Up to 72 per cent. mortality was obtained with a bait of bran moistened with water and containing 1 per cent. sodium arsenite, used at a rate of about 16 lb. per acre, and 85 per cent. with one containing 2 per cent. sodium arsenite applied at 16 lb. per acre, which is recommended. Experiments with dry bait gave inconclusive results. Sodium fluosilicate, at 4 per cent., appeared to be a satisfactory substitute for sodium arsenite, but the results were not conclusive. The optimum time for spreading the bait was before 8 a.m. in the morning. Sheep that grazed on baited areas for four consecutive days showed no ill effects. Although no experiments were made on spraying with crude oil, observations on work in progress indicated that it is relatively ineffective, extremely wasteful and should be abandoned. Ploughing of egg-sites is also considered useless. Modernisation of control methods and concentration of attention on outbreak areas during the intervals between outbreaks are advocated as a general policy in Iraq.

Chauvin (R.). **Une nouvelle méthode d'appréciation de l'effet de groupe chez les acridiens migrateurs.**—*Ann. Sci. nat.* (11) **5** pp. 79–87, 4 figs., 1 ref. Paris, 1944.

Adults of *Schistocerca gregaria*, Forsk., have a lower content of acridioxanthine in the solitary phase than in the gregarious phase, but since no method is available for isolating this pigment, direct quantitative estimation to differentiate the phases biochemically is impossible. The author describes a colorimetric method that makes it possible to arrive at an approximate index of the degree of transformation from one phase to another.

Lever (R. J. A. W.). **Entomological Notes.**—*Agric. J. Fiji* **15** no. 2 pp. 45–50, 17 refs. Suva, 1944.

Pea, banana and the noxious weed, *Solanum torvum*, are added to the previous list of food-plants of *Prodenia litura*, F., in Fiji [*R.A.E.*, A **31** 361].

In July-August 1943, pea seedlings were defoliated when the larvae were not removed by hand-collection within a few days of the unfolding of the first true leaves. Damage to banana was observed only once, the larva feeding on the unrolled leaf, which, on expansion, exhibited regularly-spaced holes. Additional parasites of the larvae [*loc. cit.*] are *Apanteles* sp. and *Euplectrus* sp.

Information has been received that the growth of the local species of banana (*Musa fehi*) in Tahiti has greatly increased in vigour since the introduction from Fiji in 1937 of *Plaesius javanus*, Erichson, against *Cosmopolites sordidus*, Germ. [**27** 212]. In an isolated locality in which only 18 adults of this Histerid had been liberated, 11 were recovered in a quarter of an hour in December 1943, and a further 100 were taken a few days later. Other weevils associated with banana in Fiji are *Stenommatus musae*, Mshl., the range of which extends to Java, Tahiti and Hawaii, and *Polytus mellerborgi*, Boh.

SAUER (H. F. G.). **Combate à broca do algodoeiro** *Gasterocercodes brasiliensis* **Hambl. (Col. Curc.), nociva às culturas do algodão arbóreo.** [The Control of the Cotton Borer, *Eutinobothrus brasiliensis*, as a Pest of Tree Cotton.]—*Arq. Inst. biol.* **14** pp. 1–14, 4 pls., 1 fig. São Paulo, 1943. (With a Summary in English.)

The method of controlling *Eutinobothrus* (*Gasterocercodes*) *brasiliensis*, Hambleton, on cotton by means of arsenicals [*cf. R.A.E.*, A **29** 624, etc.] can safely be applied throughout central and southern Brazil, but it was not known whether it was also applicable to the north-eastern region between the States of Bahia and Piauí. The cotton-growing season there differs from that in the more southerly regions, and in addition to plantings of annual cotton in the coastal areas, there are numerous small plantations of perennial tree cotton in the interior. A variety of *E. brasiliensis* occurs throughout this region and causes considerable damage to both varieties. It frequently causes total loss of newly planted tree cotton and loss of shoots, weakening and occasionally the death of older plants. The methods of cultivation are primitive, prunings are generally left on the ground and abandoned plantations provide favourable breeding grounds for the weevil.

Experiments were therefore carried out in 1941 in the State of Paraíba in which adult weevils were confined in glass cages on the stems of plants that had been sprayed with arsenicals at concentrations of 0·5, 0·8 and 1 per cent. The numbers of days that elapsed before mortality was complete were 5, 4 and 4 for calcium arsenate and 7, 7 and 6 for lead arsenate, respectively. The weevils fed very little, and laid no eggs after the third day, whereas those confined on unsprayed stems remained normal. Good control of the weevils was also obtained in a heavily infested, old plantation that was treated in early June ; mortality of the plants was checked and the attack on the upper branches and shoots reduced.

It is concluded that calcium arsenate is the more effective. The plants can either be sprayed with it or the stems and branches can be brushed with a suitable wash. For spraying, it should be used at 7 lb. in 96 gals. water, with an equal amount of lime and an adhesive. The best adhesive was found to be " pitch soap," of which the correct amount is prepared by heating 10 lb. ground pitch and 8 oz. commercial sodium carbonate in 4 gals. water until it boils. It should be added to the spray liquid while still hot, should be used at half the concentration on young plants, since it may scorch them, and itself possesses some repellent properties. If the trees are to be brushed, the formula recommended is 7 lb. calcium arsenate, 20 lb. lime and 4 gals. water. In new plantations, spraying should begin when the plants are 6–8 ins. high and should be repeated at intervals of 20 days, or less if rain intervenes, and 50 days during the dry season. The lower part of the stem should be kept well covered with the deposit, and clean cultivation will assist application. If the plants are well grown, the soil

should be removed from about the stem and all dead wood removed before spraying or brushing ; the soil is later heaped up round the stem so as to cover part of the treated area. In old plantations, the trees should be pruned and the bark scraped before treatment, which in this case should extend somewhat further up the tree. Practices that assist control are cultivation of the soil before planting, increased sowing rates to permit later elimination of infested plants, the simultaneous or previous planting of trap-crops of cotton, clean cultivation and the destruction of all prunings and plant débris. Abandoned plantations should be broken up and burnt.

Bergamin (J.). **Contribuição para o conhecimento da biologia da broca do café** *Hypothenemus hampei* **(Ferrari, 1867) (Col. Ipidae).** [A Contribution to Knowledge of the Biology of the Coffee Berry Borer, *Stephanoderes hampei*.] —*Arq. Inst. biol.* **14** pp. 31–72, 7 graphs, 83 refs. São Paulo, 1943. (With a Summary in English.)

The author reviews the history of the spread of *Stephanoderes* (*Hypothenemus*) *hampei*, Ferr., on coffee from Uganda to various parts of the world. Its presence in São Paulo was first officially recognised in 1924, and it was then so widespread that eradication was deemed impossible. He summarises the various measures that were adopted against it, describes the morphology of all stages and gives a detailed account of laboratory investigations on its life-history, carried out there in 1940–41, the results of which are compared with those previously recorded from São Paulo [*R.A.E.*, A **15** 523] and Java [**11** 236].

The ratio of males to females was found to be 1 : 9·75 ; some unfertilised females oviposited, but their eggs were undersized and did not hatch, so that in nature a single male probably fertilises about ten females. Very few infested berries did not contain a male, and males were usually the first to complete their development ; they fertilised not more than two females daily, so that some of the latter had to wait several days before pairing. The females became sexually mature 3–4 days after emergence. After pairing, they usually leave the fruits in which they developed and oviposit in others, and all those that emerged normally from coffee fruits had been fertilised. They required about 2–3 days to construct their egg-galleries in the seeds of the new berries, and the total pre-oviposition period sometimes exceeded ten days. Oviposition generally begins in January–February, when the seeds are well formed, and continues as long as suitable fruits are available, though it is more or less interrupted at harvest until the new crop develops. Two or three eggs were laid daily under favourable conditions, but the numbers laid in a single fruit decreased after about 20 days. The parent female remained in the fruit in which its eggs were deposited until the emergence of adult progeny and then migrated to another suitable fruit and resumed oviposition. Eggs were not laid in very green fruits, though the females sometimes entered them. The average length of life of the females was 156·6 days, and the total period of activity, including interruptions in oviposition, 131 days. The average total number of eggs laid per female was 74·1. Three males under observation survived for 78–103 days. The males feed little, but those placed beside a coffee fruit entered it. They do not usually leave the fruits in which they develop.

Many observations were made on the duration of development. The combined results showed that the egg-stage averaged 7·6 days at 23·1°C. [73·58°F.], the larval stage 13·8 days at 24·8°C. [76·64°F.], and the pupal stage 6·4 days at 25·8°C. [78·44°F.] ; the prepupal stage lasted two days at 22–27°C. [71·6–80·6°F.] and 3–6 days at 18–21°C. [64·4–69·8°F.]. Complete development from egg to adult averaged 27·5 days at about 24·5°C. [76·1°F.]. The number of larval moults was one for males and two for females. In continuous breeding experiments in which the results were based on the appearance of the first females in each generation, seven generations were completed in a year. It is

concluded that in the field four generations are completed between January–February, when infestation begins in the developing crop, and the end of May, when the fruits are picked. If the harvest is delayed, there may be five. Breeding continues in fallen or rejected fruits if humidity is sufficient, so that seven may be completed under favourable conditions.

SAUER (H. F. G.). **Notas sôbre a biologia de** *Ecpantheria hambletoni* **Schaus (Lepid. Arct.).** [Notes on the Biology of *E. hambletoni*.]—*Arq. Inst. biol.* **14** pp. 73–80, 1 pl., 1 fig. São Paulo, 1943. (With a Summary in English.)

Descriptions are given of all stages of *Ecpantheria hambletoni*, Schaus, which is known to attack cotton. Eggs and a female of this Arctiid were observed in 1937 on *Hibiscus sabdariffa*, and one larva was found on loquat (*Eriobotrya japonica*) in 1938 and another on cotton in 1940, all in the neighbourhood of Campinas, in the State of São Paulo. The eggs were taken to the laboratory and used for rearing experiments. It was found that the larvae would feed on *H. rosa-sinensis*, *H. esculentus*, cassava (*Manihot utilissima*), castor (*Ricinus communis*) and *Bidens pilosa*, though they seemed to prefer *H. sabdariffa*. Adult males and females survived for averages of 7·2 and 16·2 days, respectively, when unfed and 12·3 and 17·3 days when given honey and water. Complete life-cycles were observed in the laboratory on *H. sabdariffa* and cotton. The eggs were laid, usually in groups, on the lower surface of the leaves, and, less commonly, on the upper surface and on the petioles and stems. The average total number per female was 1,879 and the average laid per day 199. The oviposition period lasted 4–17 days and averaged 11. The larvae fed on the leaves, at first gregariously, and then spun cocoons in which they pupated. There were seven larval instars on cotton and eight on *H. sabdariffa*. Development from egg to adult averaged 84·2 days at 22·7°C. [72·86°F.] and 116·8 days at 18·7°C. [65·66°F.]. The durations of the individual stages are shown in tables. An undetermined species of *Eurytoma* was bred from the pupae.

LEPAGE (H. S.). **A " escama vermelha " dos** *Citrus* **em São Paulo** *Aonidiella aurantii* **(Maskell) (Homoptera—Coccoidea).** [The Red Scale of *Citrus*, *A. aurantii*, in São Paulo.]—*Arq. Inst. biol.* **14** pp. 311–330, 9 pls., 2 figs., 10 refs. São Paulo, 1943. (With a Summary in English.)

An account is given from the literature of the bionomics of *Aonidiella aurantii*, Mask., on *Citrus* in California, and of its world distribution. Up to 1932, it had been observed in Brazil only on rose [*cf. R.A.E.*, A **25** 677, etc.], on which it had occurred sporadically in the States of São Paulo, Ceará, Rio Grande do Norte, Paraíba and Rio Grande do Sul, and it did not attack *Citrus* even in close proximity to roses. From that year, however, it was recorded on *Citrus* from time to time in various localities, notably in São Paulo and in Paraíba, where it occurred in 1941 on *Citrus*, tamarind (*Tamarindus indica*), rose and papaya (*Carica papaya*). It was further observed on tung (*Aleurites fordi*) in Paraná [**26** 502] and Rio Grande do Sul. In São Paulo, it occurred on *Citrus* in two groves at Pitangueiras in 1934. Various control measures were adopted, including the destruction of infested plants, but the infestation increased, and by 1937 the situation was serious. Official cognisance was taken in that year, and strict measures to limit and control the outbreak were prescribed. These included various oil sprays, which were ineffective, and fumigation with hydrocyanic acid gas, which gave good initial mortality but did not prevent the infestation from regaining and even exceeding its former level in a few months. In 1940, infestation was still undiminished, and the Coccid was also observed locally on *Brachiaria plantaginea*, *Urena lobata*, *Sida* spp. and *Aleurites moluccana*. At the end of that year, all treatment in the groves was suspended owing to war conditions, including also spraying with Bordeaux mixture against

scab (*Elsinoe fawcetti*). This was followed by a great increase of entomogenous fungi parasitic on *Aonidiella* and of predacious Coccinellids, including *Azya luteipes*, Muls., *Pentilia egena*, Muls., *Cryptognatha* sp. and *Coccidophilus citricola*, Brèth., which was the most numerous [*cf.* **30** 585]. The Coccinellids had not previously been observed in the groves, their absence having probably been due to the oil sprays. The spread of the fungi was assisted by spraying trees on which they did not occur with a suspension of the spores and suspending twigs on which they had become established in the trees. A bacterial disease of the Coccid also appeared and caused considerable mortality. The infestation decreased progressively in 1941, 1942 and 1943 owing to these agencies, and it was thought that control would ultimately be complete. Scab increased, but this was regarded as less serious than infestation by the Coccid.

In laboratory experiments, the form of *Aonidiella aurantii* that attacked *Citrus* was successfully transferred to rose, but the form on rose did not become established on *Citrus*.

Lepage (H. S.) & Giannotti (O.). **Notas coccidológicas (Homoptera-Coccoidea).** —*Arq. Inst. biol.* **14** pp. 331–350, 41 figs., 16 refs. São Paulo, 1943. (With a Summary in English.)

Descriptions are given of eleven species of Coccids, of which ten, including two that are new, are from Brazil. Those recorded from economic food-plants comprise *Targionia* (*Aspidiotus*) *jaboticabae*, Hemp., on *Myrciaria jaboticaba*, and *Protopulvinaria longivalvata*, Green, on leaves of jasmine and avocado, both in São Paulo, and *Melanaspis saccharicola*, Costa Lima, on sugar-cane and *Pennisetum purpureum* in Rio de Janeiro.

Bergamin (J.). **Métodos de laboratório para observação e criação de *Diatraea saccharalis* (Fabricius, 1794), a broca da cana.** [Laboratory Methods for the Observation and Breeding of the Sugar-cane Borer, *D. saccharalis*.]— *Arq. Inst. biol.* **14** pp. 351–354, 1 pl. São Paulo, 1943.

Descriptions are given of two methods of rearing *Diatraea saccharalis*, F., on sugar-cane in the laboratory. Eggs are obtained by allowing caged females to oviposit on pieces of cane leaves. The larvae hatch in about eight days, and the first method is designed to permit observation of their behaviour. A hole of about the diameter of a sugar-cane stalk and a narrow slit leading into it are cut through a piece of thin board. The board is placed on a glass plate, a thin section of sugar-cane stalk from the upper internodes is fitted into the hole and a larva is introduced into the slit. Another glass plate is then placed on top, and the whole held together with rubber bands. The food should be changed every two or three days, and the apparatus kept in a damp chamber. As the larvae grow, they are transferred to boards with larger slits. Under these conditions and at a temperature of 23·6°C. [74·48°F.], the larval stage lasted 26 days. The larvae form their pupal cells in the slits, enter the prepupal stage, which lasts 2–4 days, and pupate. The pupae can be left in the slits or transferred to petri dishes. The constant change of food delays larval development somewhat, and the second method was designed for obtaining the true duration of the stages. Groups of ten newly hatched larvae are placed on pieces of sugar-cane stalk, which they enter, and are covered with bell-jars. The food is changed regularly, and the number of larvae per jar reduced until when they become full-fed there is only one. The full-fed larvae construct exits for the emergence of the adults and when this occurs, the pieces of cane are split so that the dates of pupation and transformation can be observed. Between observations, the cane is held together with rubber bands. This method is considered suitable for large-scale laboratory rearing.

KNOWLTON (G. F.). *Sinea diadema* **Feeding Notes.**—*Bull. Brooklyn ent. Soc.* **39** no. 2 p. 71. Lancaster, Pa., 1944. **Some Insect Food of the Two-spotted Collops.**—*T.c.* pp. 71–72.

Records are given of *Sinea diadema*, F., and *Collops bipunctatus*, Say, feeding on various insects, notably Aphids, in Utah in 1942–43. The insects attacked by *S. diadema* included *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) and larvae of the alfalfa weevil [*Hypera variabilis*, Hbst.] and of *Colias* (*Eurymus*) *eurytheme*, Boisd., on lucerne, and those attacked by *Collops bipunctatus* [*cf. R.A.E.*, A **33** 106] included *M. onobrychis* on lucerne and *Myzus persicae*, Sulz., on beet.

RAWLINS (W. A.), STAPLES (R.) & PRATT jr. (J. J.). **Bordeaux Formulae and Potato Insect Control.**—*J. econ. Ent.* **37** no. 4 pp. 486–492, 3 graphs, 2 refs. Menasha, Wis., 1944.

As the Bordeaux mixture commonly recommended for use on potatoes in New York against late blight (*Phytophthora infestans*) does not always give adequate protection against *Epitrix cucumeris*, Harr., and *Empoasca fabae*, Harr. [*cf. R.A.E.*, A **32** 6], field and insectary experiments were carried out in 1940–43 to determine the value of Bordeaux mixture as a repellent to these insects and to find a formula satisfactory against them. All amounts are per 50 U.S. gals. water. The proportions of hydrated lime were varied from 1 to 8 lb. and those of copper sulphate from 2 to 8 lb. in the greenhouse and from 4 to 8 lb. in the field. Potted plants were thoroughly wetted with the spray, allowed to dry, and then kept in a greenhouse containing large numbers of flea-beetles for several days. When plants were treated with 2, 4 and 8 lb. hydrated lime, alone or with equal quantities of copper sulphate, counts of the number of feeding holes per leaf showed that increasing the concentration gave increased protection in both cases, but that Bordeaux mixture was significantly more effective than lime alone. Similar results were obtained in small field plots, in which Bordeaux mixture (4 lb. : 8 lb.) was more effective than hydrated lime (8 lb.) in preventing flea-beetle and leafhopper injury. In tests in the insectary with all combinations of 2, 4 and 8 lb. each of copper sulphate and lime, increasing the quantity of either component progressively increased the repellent effect of the spray to flea-beetles, the most pronounced increase occurring when the other was most dilute. A high concentration of either material gave good repellency, but increasing the concentration of one when the other was used at a high rate did not materially improve the effectiveness of the treatment.

In field experiments, the sprays were applied at 110 U.S. gals. per acre at a pressure of approximately 400 lb.; populations of *Epitrix* and *Empoasca* were sampled by sweeping with a net, and injury was estimated by counting the number of feeding holes and the number of leaflets injured, respectively. In 1940, seven applications were made of Bordeaux mixture containing 4 lb. copper sulphate and 1, 2, 4 and 8 lb. lime. Increasing the lime from 2 to 8 lb. caused progressive decreases in the populations of both insects and in the damage they caused and a progressive increase in the yield of tubers. The neutral mixture (4 : 1) was slightly superior to the next concentration in both insect control and yield, but the difference was doubtfully significant, and tests with it were discontinued as it was used with considerable risk of plant injury. In 1941, when seven applications were again made, progressively increasing the lime from 2 to 8 lb. in Bordeaux mixture containing 4 lb. copper sulphate caused corresponding increases in repellency; increasing the copper sulphate content from 4 to 6 lb. in a mixture containing 4 lb. lime slightly increased the repellency of the spray, but increasing it to 8 lb. had no effect. Increasing the content of lime, especially at the lower concentrations, caused an increase in tuber yield, but increasing the copper sulphate did not affect it. In 1942, concentrations of

4 and 6 lb. copper sulphate and 2, 4, 6 and 8 lb. lime were tested. Increasing the concentration of lime, particularly from 2 to 4 lb., again increased the repellent value and the yield ; in the mixture containing only 2 lb. lime, 6 lb. copper sulphate was better than 4 lb., but in the others there was no material difference between 4 and 6 lb.

It is concluded that concentrations of copper sulphate above 4 lb. are unnecessary if the spray contains enough hydrated lime, and that the amount of lime depends on the dilution at which the copper sulphate is used. The most effective formula (4 : 8 : 50) did not entirely prevent injury, but analysis of yields indicated that the advantage of using more than 4 lb. lime is of questionable significance.

GRANOVSKY (A. A.). **Tests of DDT for the Control of Potato Insects.**—*J. econ. Ent.* **37** no. 4 pp. 493–499, 1 fig. Menasha, Wis., 1944.

Materials tested for the control of the common insect pests of potato, particularly the flea-beetle, *Epitrix cucumeris*, Harr., and the potato leafhopper, *Empoasca fabae*, Harr., in Minnesota in 1943 included DDT [2, 2-bis. (para-chlorphenyl)-1, 1, 1-trichlorethane]. A dust of 5 per cent. DDT in Pyrax ABB [pyrophyllite] was applied late in the evening at approximately 25 and 30 lb. per acre five times, on 20th July and 2nd, 12th, 19th and 27th August, and the insect populations were determined the day before and the day after each treatment. Few flea-beetles were present before the first dusting and none the day after it. They were more numerous by 1st August, and comparison of treated and untreated plots from that time showed highly significant reductions in populations on the former throughout the season. DDT also showed remarkable control of *Empoasca* within about 12 hours, and its residual efficiency against both species lasted for two weeks. The progressively greater differences in the populations of both insects on treated and untreated plots after each application are assumed to indicate that the insecticide has a cumulative residual value.

On heavily infested potatoes to which dusts containing 2·5 and 1 per cent. DDT were applied at 25 lb. per acre on 23rd August, both concentrations caused highly significant reductions in flea-beetle populations 2, 4 and 6 days after treatment, the more concentrated one giving somewhat higher mortalities. They also caused highly significant reductions in the populations of *Empoasca* two days after treatment, but in the later counts the differences were not significant, possibly because of the agility and migration of the insects. In the case of *Lygus oblineatus*, Say, the percentage reduction of population gradually increased, so that the control of this Capsid was considerably greater after six days than after shorter intervals, possibly because it takes longer to kill a larger insect by contact or because the dust on the leaves has a residual contact value.

In another field, a dust of 5 per cent. DDT applied at 30 lb. per acre on 6th August caused highly significant reductions in the numbers of *Empoasca* one day after treatment. There was no significant control of *Epitrix* because the initial numbers were too low. General field observations indicated that other leafhoppers, particularly *Macrosteles divisus*, Uhl., are affected by DDT in much the same way as *Empoasca fabae* ; that *Adelphocoris lineolatus*, Goeze, which is very common in potato fields in Minnesota, and *A. rapidus*, Say, which is less so, are similar to *L. oblineatus* in reaction ; and that *Leptinotarsa decemlineata*, Say, is quite effectively controlled, especially in the larval stage.

In addition to its insecticidal value, DDT appeared to have considerable fungicidal effect, as late blight [*Phytophthora infestans*] was not so prevalent in plots dusted with 5 per cent. DDT as in others treated with some fungicides commonly used on potato. It can apparently be used without damaging the plants and without risk to man or domestic animals.

CUTRIGHT (C. R.). **Populations of the European Red Mite as affected by Spray Schedules.**—*J. econ. Ent.* **37** no. 4 pp. 499–502, 3 figs. Menasha, Wis., 1944.

Since unusual fluctuations had been observed in populations of the European red mite [*Paratetranychus pilosus*, C. & F.] on apple in north-eastern Ohio, investigations on its numbers throughout each season on plots sprayed with representative schedules were carried out in 1939–44. There was little difference between the populations on trees sprayed with lime-sulphur and flotation sulphur paste, which had lately replaced the former as a fungicide in many orchards in 1939–42, and with lime-sulphur and wettable sulphur in 1943. Comparison of trees treated with flotation sulphur throughout the season and those that received no sulphur after the petal-fall spray or no sulphur at any time indicated that injury due to *P. pilosus* increased with the amount of sulphur in the programme, because the principal natural enemies are predacious mites of the genus *Seius*, which are particularly susceptible to sulphur [*cf. R.A.E.*, A **30** 536]. The improved control of *P. pilosus* by *Seius* if sulphur is omitted from the spray schedule is, however, of little practical value in commercial orchards because a fungicide is usually necessary. Tests with the fungicide Fermate [ferric dimethyl dithiocarbamate] showed that its effect on populations of *Paratetranychus* was almost identical with that of flotation sulphur, though summer oil did not lose its effectiveness against the mite when combined with Fermate. Other fungicides are not suited for use on apple in northern Ohio, so that the use of sulphur will probably be continued.

To obtain control of *P. pilosus*, sulphur schedules should be preceded by dormant oil, and in seasons in which populations develop rapidly this may have to be supplemented by the use of a summer acaricide, such as 1–1·5 per cent. summer oil or a dinitro spray, applied when injury is likely. Treatment with DN-111 [which contains 20 per cent. of a dicyclohexylamine salt of 2, 4-dinitro-6-cyclohexylphenol] at the rate of 1¼ lb. per 100 U.S. gals. on 7th August reduced the number of mites per leaf on a plot that had received no dormant oil from 15·3 to 0·1, and the population was still only 0·3 per leaf a fortnight later, so that this type of control schedule is promising.

HAEUSSLER (G. J.) & CLANCY (D. W.). **Natural Enemies of Comstock Mealybug in the eastern States.**—*J. econ. Ent.* **37** no. 4 pp. 503–509, 11 refs. Menasha, Wis., 1944.

Five parasites of *Pseudococcus comstocki*, Kuw., were introduced into the United States from Japan during 1939–41, some were propagated in Virginia, and all were released in orchards infested by the mealybug. Parasites already present comprised the solitary Encyrtid, *Clausenia purpurea*, Ishii [*cf. R.A.E.*, A **33** 109] and the gregarious Platygasterid, *Allotropa convexifrons*, Mues. [*cf.* **32** 92, etc.]. Attempts to introduce a breeding stock of the latter from Japan in 1940 and 1941 were unsuccessful. Of the introduced parasites, *A. burrelli*, Mues., and an Encyrtid of the genus *Pseudaphycus*, became well established, and their colonisation is being continued. The number of individuals of *A. burrelli* that emerged from a single host varied from 1–2 for the early nymphal stages to an average of 11 and a maximum of 57 for mature mealybugs. The ratio of males to females was approximately 1 : 3. During 1940–42, about 33,000 parasitised hosts were placed in the field and about 250,000 adults of the parasite were released in 33 infested orchards in Connecticut, New Jersey, Virginia, West Virginia, Ohio and Georgia. Examination of mature female mealybugs collected after the liberations showed that the parasite had become well established at most of the colonisation points, and had increased considerably in many. It spread rapidly through an orchard from the point of liberation, and there was little evidence of attack by native hyperparasites. An average of

6–7 adults of *Pseudaphycus* sp. and a maximum of 25 were reared from mature parasitised mealybugs and occasional solitary individuals from the early instars. The ratio of males to females was 1 : 3 or 1 : 4. The life-cycle may be as short as 17 days during summer, and the species can readily be propagated in the laboratory. Nearly 7,000 parasitised hosts had been placed in the field and more than 81,000 adults of the parasite had been colonised in 22 infested orchards in Connecticut, New Jersey, Virginia, West Virginia and Ohio by the end of 1942. The parasite was recovered from most of the orchards and increased rapidly, especially in areas in which it encountered comparatively little competition from other species. Its ability to spread appeared to be at least equal to that of *A. burrelli*, but it is subject to attack by native hyperparasites, and this may limit its effectiveness.

Approximately 11,500 adults of an undescribed species of *Allotropa* that develops as a solitary parasite of the young nymphs, all of which were reared from the imported material, were colonised in Virginia and West Virginia in 1940 and 1941, but no recoveries were made. Two small experimental colonies, totalling 131 adults, of an Encyrtid of the genus *Anagyrus* were released in Virginia, but it did not apparently become established. During 1940–41, approximately 22,300 adults of an undescribed species of *Leptomastix* were colonised in orchards of Connecticut, Virginia, West Virginia, Ohio and Georgia, but although this Encyrtid was recovered in small numbers at several liberation points it did not become established, probably because of concentrated attack by native hyperparasites.

The degree of parasitism by *Clausenia*, *Allotropa burrelli*, *Pseudaphycus* sp. and *Leptomastix* sp. in 1940, 1941 and 1942 in all infested orchards under observation is shown in a table. In most localities the total percentage parasitism in any season increased with each succeeding generation of the host. A general increase in total parasitism over the entire period was apparent in all but one of the districts of Virginia, West Virginia and Ohio in which work has been carried out for more than one season. It was evident that *A. burrelli* and *Pseudaphycus* sp. were rapidly increasing in most of the districts in which they were colonised, particularly where there was least competition by *Clausenia*. Parasitism by the latter usually had little noticeable effect in reducing mealybug injury during a given season, but in a number of orchards extremely high parasitism of the third generation of mealybugs effected considerable reduction in damage in the following year.

Various predacious insects, a list of which is given, have been recorded as attacking *P. comstocki* in the United States, including *Eurychilopterella luridula*, Reut., which has been stated to afford appreciable control on apple in South Carolina [**30** 440]. This Capsid was present in almost all the apple orchards in Virginia in which observations were made and was particularly numerous in those most heavily infested, but little control by predators was observed. Experimental mass releases of *Cryptolaemus montrouzieri*, Muls., indicated that this Coccinellid was ineffective against the mealybug on apple in Virginia. An unidentified entomogenous fungus frequently kills large numbers of mealybugs in apple orchards in Virginia, and also infests them in Ohio, West Virginia and New Jersey, but it is too dependent on weather conditions to give consistent control. Parasites were of more value in reducing the host population and keeping it at a low level.

Nickels (C. B.) & Pierce (W. C.). **Control of the Pecan Nut Casebearer with Lead Arsenate, Nicotine Sulfate, and Summer Oil.**—*J. econ. Ent.* **37** no. 4 pp. 510–512. Menasha, Wis., 1944.

Experiments to determine the relative effectiveness of nine spray treatments against the first-generation larvae of *Acrobasis caryae*, Grote, on pecan were carried out in heavily infested orchards in southern Texas in 1941 and 1942.

More than three-quarters of the total injury was caused by the first generation in both years ; larvae of the second and third generations were abundant in 1941, but scarce in 1942, the decrease being attributed largely to biological factors. Insecticide quantities are given per 100 U.S. gals. ; they were 6 lb. lead arsenate (unless otherwise stated) alone, 6 lb. lead arsenate with 13 fl. oz. nicotine sulphate (40 per cent. nicotine) and 3 U.S. quarts commercial summer-oil emulsion (83 per cent. oil), and 6 lb. natural cryolite with 2 U.S. quarts oil emulsion. Zinc sulphate (2 lbs.) was added to all sprays, primarily to control pecan rosette, but also to reduce the danger of arsenical scorching ; control trees were sprayed with this material alone. The effectiveness of the treatments was determined by estimating the yield of nuts per sq. ft. of trunk section and in some cases the percentage of nuts retained in marked clusters at harvest (shown in brackets after the yield).

On the Burkett, Halbert and Texas Prolific varieties of pecan in one orchard, treatment with 8 lb. lead arsenate on 8th May 1941 resulted in yields of approximately 36·5, 23·5 and 12·4 lb., respectively, and the same treatment on 12th May in 16·6 (18 per cent.), 15·8 and 12·4 lb. Treatment with lead arsenate on 9th and 15th May gave 19 (18·7 per cent.), 22·2 and 17·8 lb., and treatment with lead arsenate, nicotine sulphate and oil on 8th–9th and 15th May, gave 67·8 (56·1 per cent.), 36·8 and 45 lb. This treatment on 8th–9th May only gave 42·4 lb. for the first variety, and cryolite and oil, applied on 7th–8th and 15th May, gave 26·9 and 7·8 lb. for the second and third. On the control plots, the yields averaged 0·4 (0·1 per cent.), 1·3 and 2 lb. In another orchard of the Burkett variety, treatment with lead arsenate on 10th and 16th May, with lead arsenate, nicotine sulphate and oil on 16th May and with 8 lb. lead arsenate on 10th May resulted in yields of 58, 85·2 and 35·1 lb., respectively, as compared with 1·7 lb. on the control plot. In October, hibernacula were found on 8 per cent. of shoots of Burkett trees that had received two sprays of lead arsenate, nicotine sulphate and oil and on 34 per cent. of the shoots of Burkett controls ; the number present on the former was probably sufficient to cause a severe infestation during the following season.

In 1942, sprays were applied on 5th–6th and 12th–13th May. One application (on the first date) of lead arsenate, nicotine sulphate and oil gave a yield of 42·1 lb. (48·1 per cent.) for the Burkett variety, and two gave yields of 50·7 lb. (60 per cent.) for this variety and 115·2 lb. for the Halbert variety ; one application of this spray on the first variety resulted in 44·3 lb. when it was followed by nicotine sulphate and oil without lead arsenate and 50·3 lb. (55·6 per cent.) when followed by lead arsenate alone. Two applications of lead arsenate on each of the two varieties gave yields of 36·5 lb. (38·9 per cent.) and 89 lb., respectively ; a third application on 17th June against the second generation did not improve control. A spray of lead arsenate followed by one of lead arsenate, nicotine sulphate and oil gave a yield of 40·8 lb. (42 per cent.) on the Burkett variety. Control trees of the two varieties had yields of 2·1 (5 per cent.) and 5·2 lb., respectively.

In all tests, two applications of lead arsenate, nicotine sulphate and oil gave the best results. There was no evidence of tree injury from this treatment, but it is probably unsafe on pecan foliage except in semi-arid or arid climates.

Ivy (E. E.) & Ewing (K. P.). **Residual Effects of Insecticides on the Cotton Leafworm.**—*J. econ. Ent.* **37** no. 4 pp. 513–515, 1 fig., 1 ref. Menasha, Wis., 1944.

In field-plot experiments carried out in Texas since 1939, in which dusts were applied several times fairly early against other cotton pests, lead arsenate and basic copper arsenate both controlled subsequent infestation by *Alabama argillacea*, Hb., whereas calcium arsenate and cryolite had no such marked residual effect. These results were confirmed during the heavy infestation in

1942, when 3–7 applications of basic copper arsenate or lead arsenate comparatively early in the season against the boll weevil [*Anthonomus grandis*, Boh.], or the bollworm [*Heliothis armigera*, Hb.] controlled *Alabama* for more than two months following the final application, in spite of rain, but calcium arsenate and cryolite were ineffective.

In view of this, three tests were made to obtain more detailed information on the residual effect of several dusts commonly used against the weevil and bollworm. In the first, the plants were dusted on 28th August and 2nd September and totals of 1·16 ins. rain fell between the applications and 6·93 ins. in the next five days, during which period a heavy infestation by *Alabama* appeared in the field. Counts on 7th September showed that the percentage reductions in the numbers of larvae per plant were 82·4 for a mixture of equal quantities of basic copper arsenate (38·7 per cent. arsenic pentoxide and 55·1 per cent. copper oxide) and sulphur, 79·4 for lead arsenate (32·8 per cent. arsenic pentoxide), and only 58·5, 50·6 and 38·5 for zinc-safened calcium arsenate (42 per cent. arsenate pentoxide and 3·5 per cent. zinc oxide), calcium arsenate (40·4 per cent. arsenic pentoxide) and cryolite (87·4 per cent. sodium fluoaluminate). The mixed dust was applied at 12 lb. per acre and the others at 6 lb. In the second test, ten half-grown larvae were confined on each of the plants used in the first test on 7th September after all the larvae present had been removed. Inspection twice a day for five days, during which time the rainfall was 2·37 ins., showed that the copper-arsenate dust caused 31·7 per cent. mortality, whereas there was none from any of the others. In the third test, plants were dusted on 23rd and 28th September with the materials used in the first test, and ten eggs were caged on each plant on 3rd October. Attempts were made to remove all eggs and larvae of *Alabama* before this, but some were overlooked. The ten eggs had hatched in each cage by 4th October, and inspection on 9th October showed percentage reductions in the numbers of living larvae per plant of 95·8 for basic copper arsenate and sulphur, 100 per cent. for lead arsenate and 89·8, 78·8 and 38 per cent., respectively, for zinc-safened calcium arsenate, calcium arsenate and cryolite. During this test only 0·55 in. rain fell.

Osburn (M. R.) & Mathis (W.). **Oil Sprays with or without Derris Resins to control Florida Red Scale.**—*J. econ. Ent.* **37** no. 4 pp. 516 519, 5 refs. Menasha, Wis., 1944.

In experimental work in Florida during the last few years, an oil of a viscosity of 106 Saybolt and 72 per cent. unsulphonatable residue was more effective in controlling *Chrysomphalus ficus*, Ashm. (*aonidum*, auct.) in the laboratory than white oils of similar viscosities or light-medium oils with 80–90 per cent. unsulphonatable residue, but the control obtained from it at safe strengths was not always entirely satisfactory. In 1942, stock emulsions of 1 U.S. gal. water, $1\frac{1}{4}$ U.S. gals. of this oil and 7 or 10 oz. colloidal bentonite clay as an emulsifier, alone or with the addition of 51 gm. derris resins (30 per cent. rotenone), dissolved in a mixture of dibutyl phthalate and trichlorethylene (2 : 1), were diluted to contain 1·25 per cent. oil and compared with a commercial emulsion containing 1·66 per cent. actual oil (viscosity 68 Saybolt, 86 per cent. unsulphonatable residue) and no treatment, in a grapefruit grove. The sprays were applied on 6th August, and examination of adult female scales on 20th August showed mortalities of 87·5 and 74·9, respectively, for the emulsions prepared with 7 and 10 oz. bentonite, 95·6 and 92·5 for the same emulsions with the addition of derris resins, 86·2 for the commercial emulsion, and 12·3 on untreated trees. The difference between treatments required for significance (at 19 : 1) was 5·6.

In a grove of Valencia oranges, stock emulsions of $\frac{1}{2}$ U.S. gal. water and 1 U.S. gal. of the same oil with $5\frac{1}{2}$ oz. bentonite clay, alone or with 41 gm. derris resins, and emulsive oil, prepared by adding 38 gm. phthalic glyceryl alkyd resin to

1 U.S. gal. of the oil, alone or with 41 gm. derris resins, were diluted to contain 1 per cent. oil and compared with a commercial emulsion and a commercial emulsive oil, both diluted to contain 1·66 per cent. oil. They were applied on 9th September, and resulted, respectively, in 75·9, 94, 80·5, 88·4, 76·1 and 80 per cent. mortality by 22nd September. The difference required for significance was 8·5.

A comparison of samples three months after each treatment failed to show any significant difference in infestations of living adult female scales, indicating that the higher mortalities associated with some treatments immediately after application did not significantly affect reinfestation. The unsprayed grapefruit trees, however, were significantly more infested than those that received any of the sprays.

Shaw (F. R.) & Bourne (A. I.). **Observations on Bee Repellents.**—*J. econ. Ent.* **37** no. 4 pp. 519–521. Menasha, Wis., 1944.

Details are given of experiments carried out in Massachusetts in May 1943 in which carbolic acid and a proprietary phenol compound were added to sprays of lead arsenate and sulphur at the rate of 1 pint per 100 gals. spray solution and creosote was added at ½–2 pints per 100 gals. in an attempt to repel honey bees from sprayed apple trees. Half of each tree was treated with a standard spray and half with spray containing repellent. All the repellents injured the blossom, but not enough to affect the crop, and none was considered effective in keeping the bees away as there was little difference in yield between the two halves of the trees and bees were observed working on blossoms on the specially treated portions within one day. The addition of lime appeared to reduce the foliage injury caused by the creosote.

Bodenstein (O. F.). **Control of the Pickleworm on Squash and Cucumber.**—*J. econ. Ent.* **37** no. 4 pp. 534–536, 9 refs. Menasha, Wis., 1944.

The results are given of experiments carried out in Virginia in 1943 to determine the toxicity of various insecticides obtainable under wartime conditions to *Diaphania nitidalis*, Stoll, on squash and cucumber. Dusts of natural cryolite (not less than 90 per cent. sodium fluoaluminate) in talc (1 : 2), Agicide (0·12 per cent. rotenone and 0·32 per cent. other derris resins), and lead arsenate in hydrated lime (1 : 4) and sprays of 4 lb. lead arsenate per 100 U.S. gals. water, alone and with Orthol-K, diluted to give 0·415 per cent. actual oil, were applied to squash on 5th and 8th June and at intervals of 6–8 days from 1st July to 16th August, and all plots, including the control, were dusted on 10th June with a fungicide. The fruit was picked at intervals of 2–3 days from 6th July to 23rd August. The cryolite gave significantly better control than the other treatments (1·63 per cent. infested fruits); the rotenone and lead arsenate dusts gave some control (7·32 and 6·62 per cent. infested fruits), but the sprays were ineffective (11·3 and 12·21 per cent. infestation as compared with 12·36 per cent. on untreated plants). Weekly applications of cryolite dust substantially increased the number of saleable fruits, keeping infestation below 3 per cent. until the last picking, except on 13th August, when it reached 5·71 per cent., whereas 6·67 per cent. of the fruits picked from the untreated plot on 28th July were infested; it appears, therefore, that applications of cryolite dust will extend the harvest of substantially uninfested squash for several weeks.

The treatments were applied to adjacent plots of cucumbers on the same dates and also on 10th, 12th, 15th and 18th June, because the striped cucumber beetle [*Diabrotica melanocephala*, F.] was numerous and there were frequent showers, but infestation by *Diaphania* was so light, probably because the more attractive squash acted as a trap crop, that it was impossible to judge the relative value of the different treatments.

Filmer (R. S.) & Smith (C. L.). **DDT as a contact Poison for Honeybees.**—*J. econ. Ent.* **37** no. 4 p. 537, 1 ref. Menasha, Wis., 1944.

In laboratory experiments, exposure for 20–30 minutes to the dry film of a spray of 0·125 per cent. DDT [2, 2-bis (parachlorphenyl)-1, 1, 1-trichlorethane] on glass plates resulted in a high kill of honeybees within 12 hours ; the deposits were found to vary from 0·01 to 0·41 mg. DDT per sq. in., and the lowest one gave approximately 100 per cent. mortality with an exposure of 30 minutes. In preliminary tests, practically all bees caged over glass plates sprayed with 0·125 per cent. DDT were killed in 12 hours, and comparison of bees exposed for periods varying from 10 to 80 minutes with untreated bees showed that exposures of 30 minutes or more caused practically complete mortality in 12 hours, while exposures of 15 minutes or less rarely caused mortality, and exposures of 20 minutes caused about 60 per cent. When the bees were exposed for periods of five and ten minutes at intervals of an hour, complete mortality occurred within 12 hours whenever the total exposure time exceeded 30 minutes. The paralytic action of the poison was often apparent after a few minutes exposure [*cf. R.A.E.*, A **32** 387] ; death did not always result.

Driggers (B. F.) & Smith (C. L.). **Field Tests of DDT to control the Peachtree Borer.**—*J. econ. Ent.* **37** no. 4 p. 537, 2 refs. Menasha, Wis., 1944.

During experiments in New Jersey in 1943 [*R.A.E.*, A **32** 385], a spray of 1 lb. DDT [2, 2-bis (parachlorphenyl)-1, 1, 1-trichlorethane] per 100 U.S. gals. water, with calcite and fish glue, was applied to the foliage and fruit of 12 five-year-old peach trees on 14th July, no effort being made to spray the trunks and crotches. When examined at the end of the following April, ten of the trees contained no larvae of *Aegeria exitiosa*, Say, one contained a single larva and one contained nine, whereas 23 of 24 untreated trees contained 1–16 live larvae and some dead ones. The larvae in the sprayed trees were all more than half grown in April and so might possibly have entered the trees before the spray was applied.

Smith (C. L.) & Driggers (B. F.). **Toxicity of DDT to *Macrocentrus ancylivorus* Rohwer.**—*J. econ. Ent.* **37** no. 4 p. 538, 2 refs. Menasha, Wis., 1944.

In view of the value of *Macrocentrus ancylivorus*, Rohw., as a parasite of the oriental fruit moth [*Cydia molesta*, Busck] on peach, tests were carried out in New Jersey to determine the effect of DDT [2, 2-bis (parachlorphenyl)-1, 1, 1-trichlorethane], which causes high mortality of fruit-moth larvae [*R.A.E.*, A **32** 374, 375], on adults of the Braconid. Exposure for 12 hours in wire cages that had previously been sprayed with 1 lb. DDT per 100 U.S. gals. water and allowed to dry resulted in complete mortality of both sexes ; there was no mortality in unsprayed cages. Exposure in untreated cages set on glass plates that had been treated with the same spray and allowed to dry resulted in only 70 per cent. kill at the end of 12 hours and 80 per cent. at the end of 36 hours, apparently because the insects spent most of the time on the wire. All cages were supplied with water and honey. In further tests exposure of 20–25 adults for 15 and 30 minutes in glass tubes (1½ ins. in diameter and 9 ins. long), containing dry residue of the same spray resulted in severe paralysis and nervous response, but mortality was only 4 and 15 per cent., respectively, after 12 hours and 26 and 42 per cent. after 36, indicating that short exposures to surfaces sprayed with DDT are not sufficient to give complete kills. Since contact with a sprayed surface for 12 hours is very likely in view of the habits of this parasite, it appears that thorough study in the field is necessary before DDT can be recommended for the control of *C. molesta*.

Bronson (T. E.) & Dudley jr. (J. E.). **A positive feeding Device for Application of Dust Mixtures.**—*J. econ. Ent.* **37** no. 4 pp. 538–539, 1 fig. Menasha, Wis., 1944.

In order to obtain accurate rates of application with dust mixtures of varied composition, which is one of the most difficult problems in insecticide tests against the pea aphid [*Macrosiphum onobrychis*, Boy.] on broadcast canning peas in the United States, the authors developed the mechanism described in this paper. It consists of a hopper containing an agitator worked by a small petrol motor and is fitted on to the hopper of a power duster; it can be adjusted to deliver the average rotenone-bearing dust at rates from 20 to over 65 lb. per acre with almost complete accuracy.

Walker (H. G.) & Anderson (L. D.). **Fumigation with Methyl Bromide for Potato Tuber Worm.**—*J. econ. Ent.* **37** no. 4 pp. 539–540, 3 refs. Menasha, Wis., 1944.

A heavy infestation of *Gnorimoschema operculella*, Zell., which developed in autumn-grown potatoes that were being stored for spring planting on the eastern shore of Virginia, was controlled by fumigation with methyl bromide at dosages of approximately 2·4 lb. per 1,000 cu. ft. in October 1941. The storehouses were made airtight and were kept closed for three hours after the fumigant was released. Its release required 15–35 minutes and the air was circulated by a fan during the process and for 15 minutes after. One storehouse contained more than 500 bushels of heavily infested tubers stored in bags, barrels and baskets, and the temperature ranged from 70°F. in the barrels to 74°F. in the upper part of the room, another was nearly filled with potatoes stored in barrels, three tiers deep, and a third was about one-third full of potatoes stored largely in burlap bags. The temperature in the last two storehouses was 75°F. Many dead larvae were found on the floor and dissected from potatoes after treatment, and no living larvae, pupae or adults were found. Examination of the stores at intervals throughout the winter revealed no living larvae, and the potatoes kept as well as might have been expected considering the condition they were in at the time of fumigation. Most of them were cut and planted in the spring of 1942 and sprouted and grew in the normal way. Larvae continued to damage potatoes taken out of the stores before fumigation.

During the summer of 1942, potatoes kept in a large storehouse at Hampton, Virginia, became so heavily infested with larvae of *G. operculella* that they had to be discarded. Fumigation of the storehouse with 2·4 lb. methyl bromide per 1,000 cu. ft. for 36 hours gave excellent control of the many moths and pupae that remained, and no larvae developed in the potatoes that were stored there later.

Flanders (S. E.). *Accrophagus notativentris*, **an important Parasite of the Grape Mealybug.**—*J. econ. Ent.* **37** no. 4 p. 541, 4 refs. Menasha, Wis., 1944.

The author briefly reviews information on infestation of vines by the grape mealybug, *Pseudococcus* sp. [? *maritimus*, Ehrh. (*bakeri*, Essig)], which is often extremely local and appears to be controlled by parasites in central California despite protection by ants [*cf. R.A.E.*, A **18** 711], and on its principal parasite, *Accrophagus* (*Pseudaphycus*) *notativentris*, Gir. [*cf.* **10** 315; **12** 588]. He reports that 100–200 individuals of this Encyrtid were liberated on vines near Pasadena, California, in 1943.

Siegler (E. H.), Bowen (C. V.) & Smith (L. E.). **Toxicity Tests of some organic Compounds and their hydrogenated Derivatives against Codling Moth Larvae.**—*J. econ. Ent.* **37** no. 4 pp. 542–543, 1 ref. Menasha, Wis., 1944.

In order to obtain data to assist in predicting the insecticidal value of a compound to the larvae of *Cydia* (*Carpocapsa*) *pomonella*, L., from a knowledge

of its chemical composition, the toxicity of some hydrogenated organic compounds was compared with that of the unsaturated parent compounds by the apple plug method [*cf. R.A.E.*, A **23** 174]. The most toxic of the compounds tested was the hydrogenation product of anthracene, 9, 10-dihydroanthracene, which gave results approximately the same as those obtained with lead arsenate and was much more effective than anthracene. Tetranaphthene was also considerably more effective than acenaphthene, but on the whole, hydrogenation did not alter the toxicity of a compound.

BARNES (O. L.). **Feeding Experiments with the Range Caterpillar Egg Parasite *Anastatus semiflavidus* Gahan.**—*J. econ. Ent.* **37** no. 4 pp. 544-545. Menasha, Wis., 1944.

In 1930–38, large numbers of the egg parasite, *Anastatus semiflavidus*, Gah., were reared in eggs of the range caterpillar [*Hemileuca oliviae*, Ckll.] in the laboratory in Arizona [for release against this Saturniid on range-grasses in New Mexico (*cf. R.A.E.*, A **21** 600; **24** 162)], and in 1932–34 experiments were made to ascertain the optimum conditions for feeding and handling the laboratory material. The results are here given of observations on the effects of various foods on the length of life of the adults, particularly the females. The average length of life of the females varied from 2·9 days with no food or water to 43 days with a 20 per cent. solution of sugar-cane syrup. It was only three days when eggs of *Hemileuca* only were provided, though females commonly feed at oviposition punctures in the field, and only 4·2 days with water alone. Solutions of honey or white cane sugar in water (1 : 4) and dry rock sugar, with water provided, all increased the average length of life to more than 30 days, but a solution of brown cane sugar, dry rock sugar alone, orange or grapefruit juice and soaked raisins were less effective. Females given honey solution for one and three days after emergence, after which water was provided, and kept in cages in the presence of males and host eggs, lived for averages of 5·1 and 6·2 days, respectively, and those given honey solution on the first day and each third day thereafter, with water on the other days, for 22·5 days, as compared with 34·7 and 34·3 days, respectively, when honey solution was provided continuously, alone and with additional water. Females caged with males and host eggs and supplied with a fresh solution of honey and water lived for 13-62 days, and others treated in the same way but fed with a highly fermented honey solution made more than six months previously for 19–58 days. The length of life of males and females given honey solution under identical conditions ranged from less than one to 38 days and from 27 to 76 days, respectively.

CHAMBERLIN (F. S.). **Economic Importance of prolonged pupal Periods of the Tobacco Hornworm.**—*J. econ. Ent.* **37** no. 4 pp. 545-546, 2 refs. Menasha, Wis., 1944.

It is known that some pupae of *Protoparce sexta*, Joh., in Florida give rise to adults after passing two winters in the soil [*cf. R.A.E.*, A **27** 251]. Of larvae collected in tobacco fields towards the end of the season in different years and kept in soil cages, 6·4 per cent. gave rise to adults in the first autumn, 25·7 per cent. to pupae that survived the winter and 0·6 per cent. to pupae that passed two winters before giving rise to adults. It has been shown that autumn ploughing kills about half the pupae overwintering in tobacco fields and additional mortality would be expected from the several autumn and winter cultivations that are common in this area, so that it was thought that the pupae that survived two winters would be too few to be of economic importance.

In the areas of Georgia and Florida in which cigar tobacco is produced, the practice of growing wrapper tobacco on the same land for several consecutive seasons is being abandoned, and it is now grown on the same land for one or

two years and followed by maize or some other crop for at least one year. It is grown under loosely woven shading material attached over a frame; this excludes the moths until towards the end of the harvesting period, when the plants push through the tops and are available for oviposition, but the resulting infestation frequently gives rise to numerous overwintering pupae. Severe infestations on shade-grown tobacco on land that had been planted with maize in the preceding year, which must have originated within the shade structures, were reported in two seasons, and in each case it was found that tobacco had been grown on the land two years before and had become heavily infested towards the end of the season. It is evident that sufficient individuals with prolonged hibernating stages developed on these tobacco crops to produce serious infestations two years later. No instances were observed in which such infestation occurred after a three-year interval.

COCKERHAM (K. L.). **Some Parasites of the Sweetpotato Weevil.**—*J. econ. Ent.* **37** no. 4 pp. 546–547. Menasha, Wis., 1944.

In 1940, a number of Hymenopterous parasites were found attacking *Cylas formicarius elegantulus*, Summers, in its mines in sweet potato and other species of *Ipomoea* in Louisiana; those of which adults were reared were *Bracon* (*Microbracon*) *mellitor*, Say, *B.* (*M.*) *punctatus*, Mues., and *Metapelma spectabilis*, Westw.

STARR (D. F.). **A Mixture of Pyridine and Iso-amyl Alcohol attractive to some Species of** *Blepharoneura*.—*J. econ. Ent.* **37** no. 4 p. 547, 1 ref. Menasha, Wis., 1944.

During tests of baits for fruit-flies carried out in a mango grove in Mexico in January 1942, two species of *Blepharoneura* were taken in some of the trap-glasses. It appeared that baits containing equal quantities of pyridine and iso-amyl alcohol were much more attractive to them than the other materials being tested, which included a fermented sugar solution that has been found attractive to *Anastrepha ludens*, Lw. [*R.A.E.*, A **26** 142].

BRETT (C. H.). **An electrically regulated Humidity Control.**—*J. econ. Ent.* **37** no. 4 pp. 552–553, 1 fig., 1 ref. Menasha, Wis., 1944.

The author describes an apparatus for controlling humidity that has been used for three years in a study of the effects of temperature, humidity and certain foods on *Melanoplus mexicanus*, Sauss. It occupies little space, is adequate for maintaining desired atmospheric conditions in any ordinary rearing compartment and is so inexpensive ($20 for total cost of parts) that many could be considered for a single investigation.

MUNGER (F.). **An Adaptation of a Thermograph to regulate variable Temperature.**—*J. econ. Ent.* **37** no. 4 pp. 554–555, 2 figs., 2 refs. Menasha, Wis., 1944.

Details are given of an apparatus designed to control fluctuating temperatures, which was prepared from a standard thermograph and operated at relative humidities up to 90 per cent. Although it was devised to reproduce variable temperature, tests indicated that it could also be adapted to reproduce fluctuating humidity.

TATE (H. D.) & HILL (R. E.). **Residual Toxicity of Sulphur to the Potato Psyllid in Greenhouses.**—*J. econ. Ent.* **37** no. 4 pp. 557–558. Menasha, Wis., 1944.

Although *Paratrioza cockerelli*, Šulc, does not occur in destructive numbers every year in Nebraska, sulphur sprays and dusts are fairly regularly applied

to potato against it as a protective measure, and experiments were therefore carried out in the greenhouse during the winter of 1941–42 on the residual toxicity of sulphur to this Psyllid. The test insects were released in cages covering individual leaves of plants that were untreated or had been sprayed with liquid lime-sulphur (33°Bé) in water (1 : 40) or 1 lb. wettable sulphur per 9 U.S. gals. water at a rate equivalent to 100 U.S. gals. per acre or dusted with sulphur (325 mesh) at 30–40 lb. per acre at various intervals previously. Records were obtained for eggs and for nymphs in the third, fourth and fifth instars. Adults were confined on potato foliage for a given period, and any eggs deposited were kept under observation until they had hatched or proved to be non-viable ; nymphs were kept on the plant until they died or transformed to adults. Relatively few eggs were laid by females confined on foliage during the first 4–5 days after treatment ; increasing numbers of eggs were laid after this, but no normal individuals hatched from them until the time between treatment and caging exceeded 12 days. When the interval was 14 days, comparatively large numbers of eggs were deposited, but only a small proportion hatched normally ; approximately normal deposition and hatching occurred in two series in which 19 and 25 days elapsed between treatment and caging. In all cases development on untreated leaves appeared to be normal.

In 11 tests on the residual toxicity of liquid lime-sulphur to nymphs, only four normal adults emerged when the intervals between treatment and caging were 6–39 days ; in 12 with wettable sulphur, none emerged after intervals of 1–36 days ; and in nine with dusting sulphur only 10 emerged after intervals of 6–39 days. The rate of lethal action and mortality decreased as the interval increased. In four tests in which plants were sprayed with lime-sulphur and exposed to about ½ inch artificial rain 1–12 days later, immediately before nymphs were confined on them, and in two similar tests with dusting sulphur in which the intervals were 5 and 12 days, only 8 of 120 nymphs transformed to normal adults ; and in five similar tests with wettable sulphur, with intervals of 5–21 days, only 13 of 100 nymphs gave rise to adults.

When all the leaves but one on a plant were sprayed with lime-sulphur and 20 nymphs were confined on the untreated leaf ten days later, all developed normally, giving rise to adults that laid viable eggs, whereas none caged on treated foliage developed normally ; when nymphs were caged on foliage that developed after treatment, development was again normal. It seems unlikely, however, that the protective value of the treatments is much affected by this fact, since the Psyllids feed largely on the more mature leaves. Nymphs caged on the untreated surface of leaflets thoroughly covered with liquid lime-sulphur on one side also developed normally, indicating that thorough coverage is essential.

HOLDAWAY (F. G.) & NISHIDA (T.). **The Toxicity of DDT to *Adoretus sinicus* in Hawaii.**—*J. econ. Ent.* **37** no. 4 pp. 558–559, 2 figs. Menasha, Wis., 1944.

Adults of *Adoretus sinicus*, Burm., which feed at night, are more injurious to green beans in Hawaii than any other leaf-eating insect, and the only insecticide known to be effective against them is acid lead arsenate, which commonly injures the foliage [*R.A.E.*, A **32** 136]. In experiments in which the beetles were caged on treated bean plants, however, DDT [2, 2-bis (parachlorphenyl)-1, 1, 1-trichlorethane] proved much more effective. The percentage mortality was 82 after one night and 100 after three for a 3 per cent. DDT dust, 65 after one night and 100 after four for a spray containing 1 lb. DDT per 100 U.S. gals. 40 and 50 after one and three nights for one containing 4 oz. DDT, and 5 and 68 after one and three nights for one containing 4 lb. lead arsenate. A spray containing 2 oz. DDT per 100 U.S. gals. and one containing 3 lb. lead arsenate both gave about 10 per cent. mortality after one night and the lead arsenate gave 89 per cent. after eight. The DDT sprays were made with a preparation that also contained a wetting agent. No mortality occurred on untreated plants in three

days and only 20 per cent. in eight. Feeding injury was slight on all plants treated with DDT and severe on untreated ones.

Confirmation of these results and some additional data were obtained in further tests with sprays containing from 4 oz. to 1 lb. DDT per 100 U.S. gals. and dusts containing from 0·25 to 3 per cent. It appeared that 2 and 1 per cent. dusts are more and only slightly less effective, respectively, than the 3 per cent. dust, that dusts containing 0·5 and 0·25 per cent. are equal in toxicity to sprays containing 8–12 oz. and 4 oz., respectively, per 100 U.S. gals., and that 0·5 per cent. dust is only slightly less toxic than a spray of 3 lb. lead arsenate with astringent per 100 U.S. gals. Many of the beetles confined for one night on plants treated with DDT were unable to crawl into the soil after they left the plant and some were dead on the soil surface. Of 36 beetles that were kept overnight in an otherwise empty cage dusted with 2 per cent. DDT, 15 were dead the following morning; those still alive were put in a clean cage with an untreated plant, but practically no feeding took place and all were dead after eight nights. Only one of 36 put into a similar cage dusted with 33·3 per cent. lead arsenate was dead after one night, and the survivors consumed a considerable amount of an untreated plant; only five were dead after eight nights.

In preliminary tests, a dust of 3 per cent. DDT caused some injury to the foliage of green bean plants in the field when the plants were wet and the application heavy. None was observed after treatment with weaker dusts or with sprays of 1 or 2 lb. DDT per 100 U.S. gals.

STEINER (L. F.). **Residual Effect of DDT Sprays on early Spring Apple Aphids.**—*J. econ. Ent.* **37** no. 4 pp. 560–561, 1 ref. Menasha, Wis., 1944.

It became apparent in the spring of 1944 that sprays of 2, 2-bis (parachlorphenyl)-1, 1, 1-trichlorethane (DDT), applied to apple trees in Indiana against *Cydia* (*Carpocapsa*) *pomonella*, L., in 1943 had caused striking reductions in subsequent infestation by Aphids. Examination of apple buds between 8th and 12th April, when hatching of the Aphids was practically complete, showed that the lowest populations in each series of tests were associated with the DDT treatments that had given the best control of the moth [*cf. R.A.E.*, A **32** 385]. On heavily infested trees as many as 40 Aphids were counted on one bud, whereas on lightly infested trees the number seldom exceeded five. *Rhopalosiphum prunifoliae*, Fitch, constituted more than 99 per cent. of the population, and was the only species present on plots having less than 10 per cent. infested buds; *Anuraphis roseus*, Baker, was more generally present than *Aphis pomi*, Deg.

Aphid populations were also affected by the length of time between the last spray and the return of the autumn migrants to apple, and more were present on buds at the tops of trees sprayed with DDT than on lower ones, whereas there was little difference on other trees. These facts suggest that the amount of DDT deposit remaining on the foliage and wood of the new fruit spurs when the Aphids begin to oviposit determines the number of eggs laid, but they afford no evidence whether the deposit acts as a repellent or as a poison.

A dust of 10 per cent. DDT applied to infested branches caused a knockdown of most Aphids present within two hours. Although these results warrant more extensive investigation of DDT for combined control of *C. pomonella* and Aphids, its high toxicity to certain parasites and predators may result in unsatisfactory control of Aphids.

MARVIN (P. H.). **Obtaining Eggs of the Potato Tuber Worm for Use in the Mass Breeding of** *Macrocentrus ancylivorus*.—*J. econ. Ent.* **37** no. 4 p. 560, 1 fig. Menasha, Wis., 1944.

In the mass breeding of *Macrocentrus ancylivorus*, Rohw., on larvae of *Gnorimoschema operculella*, Zell., for release against the oriental fruit moth

[*Cydia molesta*, Busck], in the United States [*cf. R.A.E.*, A **32** 211, 367] it is preferable to stock the trays of potato tubers in which the parasites are to be reared with eggs rather than adults of the moth, as this permits a closer control of the age of the host larvae at the time they are exposed to parasite attack, reduces the period for which each tray is in use and eliminates trouble from moth débris and scales. It was found that the moths will oviposit readily in small crevices, though not on smooth surfaces, in the absence of potato or other natural food ; the eggs cannot be handled owing to the soft adhesive material on the chorion.

A technique was therefore developed by which about 3,000 moths were put in a cage covered with 20-mesh wire netting and placed on wet sand. A 60-mesh wire gauze mat was put on top of the cage, and the moths readily oviposited through this on to brown-print paper pressed uniformly against it by a bag of sand. The gauze mat was dipped in hot paraffin wax, the excess of which was blown out of the meshes with compressed air, to prevent the eggs from adhering to it. Only one egg was laid through any one mesh. The paper was ruled in small squares to facilitate counting the eggs, and each sheet was exposed to the moths for 24 hours. By this method, 15–20 eggs were obtained for each moth used ; they were produced in large numbers for about a week, and when the daily production dropped, the cages were cleaned and restocked. The effects of individual environmental factors were not studied, but it is thought that high humidities are unfavourable for egg laying.

SMITH (H. S.). **Etherization and Refrigeration for Shipment of Insects.**—*J. econ. Ent.* **37** no. 4 p. 561, 1 ref. Menasha, Wis., 1944.

Earlier methods [*cf. R.A.E.*, A **29** 295] of transporting *Macrocentrus ancylivorus*, Rohw., from the insectary to the orchards for the control of the oriental fruit moth [*Cydia molesta*, Busck] in California are inadequate for the present scale of distribution, more than 250,000 parasites per day being obtained by rearing on the tuber moth [*Gnorimoschema operculella*, Zell.]. By a new method that is proposed as a result of experiments, the adult parasites are etherised in the emergence cabinet for collection, refrigerated and packed tightly in plastic tubes at the rate of 2,000 per tube 2 ins. long and $\frac{3}{4}$ in. in diameter. An insulated container for the tubes is being developed which, by the use of ice, will keep the parasites quiescent for 48 hours, the period considered necessary for safe transport. In a test, 2,500 adults that were anaesthetised and refrigerated for four days recovered perfectly.

SATTERTHWAIT (A. F.). *Leucopoecila albofasciata*, **a Pest of Golf Greens.**—*J. econ. Ent.* **37** no. 4 p. 562, 5 refs. Menasha, Wis., 1944.

The author describes an outbreak of *Leucopoecila albofasciata*, Reut., on the greens of a golf club in Missouri in August and September 1925. Large numbers of nymphs and adults of this Capsid were present on the grass, which was discoloured and made only 10 per cent. of its normal growth during the three weeks before 3rd September, though the plant food had been doubled and the greens liberally watered.

HOERNER (J. L.). **The Tomato Russet Mite in Colorado.**—*J. econ. Ent.* **37** no. 4 p. 562. Menasha, Wis., 1944.

In September 1943, *Phyllocoptes destructor*, Keifer, was found to be injuring tomatos in two counties of Colorado, a State from which it had not previously been recorded. It killed the plants over about three acres in one ten-acre field, but the application of sulphur dust (100 or 25 per cent.) to the remaining plants appeared to stop the injury immediately. Nine days later, crawling mites were

seen on the untreated plants, but none was found on the treated ones. When the plants were dusted, the weather was becoming cool, and probably very little additional injury would have occurred.

GENTNER (L. G.). **The Black Flea Beetles of the Genus *Epitrix* commonly identified as *cucumeris* (Harris) (Coleoptera : Chrysomelidae).**—*Proc. ent. Soc. Wash.* **46** no. 6 pp. 137–149, 91 refs. Washington, D.C., 1944.

Most of the injury to potato by black flea-beetles of the genus *Epitrix* in Oregon and Washington is due to feeding by the larvae on the tubers, though the adults cause some damage to the leaves, whereas that in the eastern United States, where tuber injury is seldom serious, is due to adults feeding on the foliage. The flea-beetles have in both cases commonly been identified as *E. cucumeris*, Harr., though those from certain western localities did not appear typical. From an examination of a large series of specimens and a study of the literature, the author concludes that at least three distinct species are involved. These are *Epitrix cucumeris*, which occurs from Canada to Florida and westward into North Dakota, South Dakota, Nebraska and Kansas, *E. tuberis*, sp. n. [*cf. R.A.E.*, A **32** 359] which has been found in Oregon, Washington, Colorado and western Nebraska, and *E. similaris*, sp. n., which is known only from California. The adults of all three species are described, their relative measurements are shown in a table, and a key is given distinguishing them from one another.

As widespread injury to potato tubers by *E. tuberis* was observed in Colorado as long ago as 1904, and the larvae are known to develop there on the roots of wild solanaceous plants [*cf.* **22** 30], the species may be native to the north of the State, living on these wild food-plants before the development of potato cultivation. It does not occur in Idaho, Montana or Wyoming ; the flea-beetle common on potato, cabbage and tomato in Idaho is probably *E. subcrinita*, Lec. *E. similaris* is said to be one of the most important flea-beetles in California, and severe damage to tomato plants by potato flea-beetles, probably of this species, was recorded there in 1935 and 1938.

HARRIES (F. H.). **Differential Effects of Temperature on the Development of the Beet Leafhopper.**—*J. agric. Res.* **69** no. 3 pp. 127–136, 3 graphs, 16 refs. Washington, D.C., 1944.

It has been found that insects develop more rapidly at varying temperatures than would be expected from results obtained at constant temperatures [*cf. R.A.E.*, A **29** 131 ; **32** 115 ; B **33** 82 ; etc.] and this has usually been attributed to a stimulus provided by the variation in temperature, but evidence also exists indicating the occurrence of several phases of growth affected differently by temperature within the same developmental stage. In view of the importance of temperature in influencing the time of maturation and migration to cultivated land in spring of *Eutettix tenellus*, Baker, as well as its seasonal development, in the United States, further experiments [*cf.* A **32** 116] were carried out to determine whether such growth phases occur in the eggs or nymphs. The relative humidity was maintained at 49–51 per cent. When eggs and nymphs were kept at 90°F. for increasing numbers of days and then allowed to complete the stage at 65 and 75°F., respectively, both stages were usually completed more quickly than would be expected from observations on development at each of the temperatures, but when they were transferred from the lower to the higher temperature, development was generally slower. The differences involved appeared to increase with the duration of the exposure to the first temperature. It is therefore concluded that the difference in the rate of growth at two temperatures is less at the beginning and greater at the end

of the embryonic and nymphal stages than is indicated by the average rates based on the time required for the completion of the entire stages at each temperature.

The progress of nymphal development at different temperatures was further studied by the daily weighing of groups of 50 nymphs reared at constant temperatures of 75, 80, 85, 90 and 100°F. until the adults emerged, and the results are presented in a table and in graphs. The curves obtained by plotting logarithms of weight against time for each temperature appeared to consist of linear segments of different slope, indicating that in five successive periods, probably coinciding with the five nymphal instars, growth took place at different constant rates. When percentage of adult weight attained was plotted against percentage of time required for development at each temperature, the curves obtained did not coincide, thus corroborating the existence of phases within the nymphal stage that are affected differently by different temperatures.

The data on the effect of successive exposure to two temperatures suggest that development in nature would be most accelerated or retarded in successive periods of different weather and in autumn and spring, when differences in daily mean temperatures are greatest. The relatively more rapid development at lower temperatures in the later nymphal instars would enable a large number of the larger nymphs, which are abundant in autumn, to complete their development before winter, which is passed in the adult stage.

PEPPER (B. B.). **Vegetable Insects and their Control on commercial Plantings.**—*Circ. N. J. agric. Exp. Sta.* no. 476, 15 pp. New Brunswick, N.J., 1944.

This summary of recommendations for the control of the more important injurious insects in commercial plantings of vegetables in New Jersey contains a chart showing the different crops, with the insects that attack them, the kind of damage caused, the appearance of the injurious stage and methods of control or prevention, very brief notes on the mixing and application of sprays and dusts and the adjustment of the machinery used, and formulae for the insecticides suggested, most of which are in accordance with official regulations as to the use of insecticides in time of war.

GOODWIN (M. W.), HOPPERSTEAD (S. L.) & KADOW (K. J.). **Insecticide Diluents. Solubility of Arsenicals and Copper Fungicides as affected by Diluents in agricultural Dusts.**—*Soap* **20** no. 8 pp. 103, 105, 107, 2 figs., 14 refs. New York, N.Y., 1944.

The results, given in this paper, of experiments on the relation between pH and the proportion of water-soluble copper and water-soluble arsenic in dusts containing various copper fungicides and calcium arsenate, have already been noticed from an abstract [*R.A.E.*, A **30** 226]. It was evident that the pH values of the separate ingredients used in dust mixtures do not always afford reliable indices for predicting the pH of their mixtures, many having a buffering effect. Attempts were made to ascertain the comparative safety of the copper compounds used. Examination of the pH of different mixtures without calcium arsenate showed that red cuprous oxide (pH 6·45) and tribasic copper sulphate (pH 6·4) had very little buffering effect on the pH of the dust, but copper oxychloride (pH 8·1) resisted change in pH, so that all mixtures containing it showed practically no water-soluble copper, because their reaction was above pH 5·5. In mixtures containing calcium arsenate, the first two compounds again had little buffering effect, the free lime in the calcium arsenate being apparently the governing factor in the final pH of the dust, whereas copper oxychloride consistently showed greater resistance to change, the final pH of most mixtures containing it being below 10, so that varying amounts of water-soluble arsenic

were liberated. Since mixtures containing cuprous oxide and tribasic copper sulphate tended to have a pH above the danger point, they are probably safer in respect to the liberation of water-soluble arsenic.

It is concluded that dust mixtures containing copper fungicides and no calcium arsenate should have a reaction above pH 5·5 and those containing calcium arsenate one above pH 11.

CLANCY (D. W.). **Biology of *Allotropa burrelli*, a gregarious Parasite of *Pseudococcus comstocki*.**—*J. agric. Res.* **69** no. 4 pp. 159–167, 2 figs., 5 refs. Washington, D.C., 1944.

An account is given of observations on the biology of the introduced parasite, *Allotropa burrelli*, Mues., made in the course of laboratory rearing of this Platygasterid in New Jersey in 1940–41 for release against *Pseudococcus comstocki*, Kuw., on apple in several States [*cf. R.A.E.*, A **31** 308; **33** 208]. The egg, larva and adults and the course of development, particularly that of the embryo, are described. Adults survived for an average of 3–5 days at 80°F., and seldom more than ten days at lower temperatures. Males generally emerged first and remained near the parasitised host to mate with the females. Oviposition began immediately if hosts were present, the eggs being deposited at random in the body cavity. From 1 to 18 eggs (average 8·8) were laid in a single act of oviposition; the number did not seem to depend on the size of the host. Dissection showed an average of 565 eggs per female parasite. Under favourable conditions, a female deposited most of its eggs in a short time, parasitising several hosts in quick succession. Nymphs of all stages were attacked, but those at least half grown were preferred. Development appeared to be almost completely monembryonic, though three cases of twinning were observed. There was considerable growth in the egg stage, and only one larval instar. At 75–80°F., these stages lasted 8–12 and 5·5–7·5 days, and the prepupal and pupal stages 1·5–2·5 and 11–16 days. The larger larvae occasionally fed on smaller ones, but this appeared to be due to chance encounter. The ratio of males to females ranged from 1 : 2 to 1 : 3, and 1–22 parasites per host were produced in the laboratory, the greatest number emerging from hosts attacked in the third instar or the early adult female stage [*cf.* **33** 208]. The parasite overwinters as a mature larva within the host, and survived cold storage in that stage for at least seven months.

LATHROP (F. H.). **Fighting the Apple Fruit Fly.**—*Misc. Publ. Maine agric. Exp. Sta.* no. 587, 2 figs., 16 refs. Orono, Me., 1944.

Although the race of *Rhagoletis pomonella*, Walsh, that infests apples and sometimes fruits of *Crataegus* and *Amelanchier* is so thoroughly controlled in Maine that it has caused little damage to apples during the past ten or twelve years, it is still sufficiently abundant to enable it to build up high populations and cause heavy losses if control is neglected. A short account is therefore given of its seasonal history and the injury due to it, together with notes on preventive measures, and control by means of insecticides and the cold storage of infested apples, most of which has already been noticed from other sources [*R.A.E.*, A **23** 324, 373, etc.]. Although the flies prefer apples, especially the early and sweet varieties, they also infest plums, pears and possibly cherries to a limited extent. Observations have shown that oviposition is most rapid and of shortest duration in early varieties of apple and least rapid and most protracted in late varieties. Satisfactory control can be obtained by lead-arsenate sprays [**22** 535], or by three applications of a dust containing lead arsenate and superfine dusting sulphur (15 : 85) at intervals of 7–10 days during the emergence period. Wild food-plants and neglected apple trees within 150–200 yards of the orchard

should be treated or destroyed, and if control in the orchard is unsatisfactory, the outer trees of adjoining woodland and shrubs and bushes in boundary fences should also be treated.

HUTSON (R.). **Controlling the Fruitworm on Blueberries.**—*Quart. Bull. Mich. agric. Exp. Sta.* **26** no. 4 pp. 283–284, 1 fig. East Lansing, Mich., 1944.

Blueberries are now being grown on a commercial scale in Michigan, and, with the development of pure stands of thriving plants, infestation by insects is assuming increased importance. The most serious injury to the fruit so far is that due to the cranberry fruitworm [*Mineola vaccinii*, Ril.]. Brief notes are given on the damage it causes [*cf. R.A.E.*, A **30** 119], together with the results of experiments on its control. The application of pyrethrum and rotenone dusts from the ground proved ineffective, but, in experiments in two years, a spray of a fixed nicotine with summer oil and one containing rotenone and a spreader applied to fully-grown plants when the berries reached the size of buckshot and again ten days later reduced infestation by 70–85 per cent. as compared with unsprayed plots. In a field test of the nicotine spray in 1943, only about 10 per cent. of berries of the first picking from the treated plants were infested, whereas the crop on untreated plants was almost completely lost.

List of Intercepted Plant Pests, 1943.—*S.R.A., B.E.P.Q.* [1943] 35 pp. [Washington, D.C.] U.S. Dep. Agric., 1944.

This list of pests intercepted between 1st July 1942 and 30th June 1943 with plants or plant products entering United States Territory (including Hawaii and Porto Rico) resembles previous ones [*R.A.E.*, A **31** 280; **32** 20] in the selection and arrangement of the data.

MALTAIS (J.-B.). **Dégâts des vers gris dans les cultures des pois de conserves, en 1942.**—*28th Rep. Quebec Soc. Prot. Plants 1936–43* pp. 37–38, 2 figs. [Quebec, 1944.]

Cutworms of the genera *Euxoa* and *Agrotis* severely damaged young peas grown for canning in Quebec in 1942 by cutting the stems at or just below soil level and caused a marked reduction in yield in one district in the south. The infested fields showed bare patches on which all the plants had been destroyed, and around which were other plants that had lost the main shoot. Subsidiary shoots produced by these plants masked the extent of the damage but were formed too late to make any appreciable contribution to the crop. Reduction in yield was much greater in early than in late peas.

DAVIAULT (L.). **Nouvelles observations sur la mouche à scie européenne de l'épinette dans les forêts du nord du St-Laurent.**—*28th Rep. Quebec Soc. Prot. Plants 1936–43* pp. 39–43, 2 graphs, 3 refs. [Quebec, 1944.]

A survey of the status of *Gilpinia hercyniae*, Htg., on spruce and of its parasites in the forests of Quebec north of the St. Lawrence [*R.A.E.*, A **30** 285] was continued in 1941 and 1942. Some of the results have already been noticed [**31** 348; **32** 353]. The numbers of sound cocoons per sq. foot of soil surface in 1942 were only one-fourth as great as in 1940; this reduction was due chiefly to the disease of the larvae [*cf.* **32** 111], which killed about 25 per cent. in 1941 and 44 per cent. in 1942. Of the native parasites, *Phorocera hamata*, Aldr. & Webber, appears to be the commonest. Eggs of this Tachinid were attached to 1·4–6 per cent. of the larvae of *G. hercyniae* collected at five places in 1941, but only four adults emerged from a total of 517 host cocoons collected at three during the two years. Other native parasites reared from cocoons

were *Tachina rustica*, Mg. (*Guerinia spinosula*, Tns.), *Hylemyia latipennis*, Zett., *Agrothereutes slossonae*, Cushm., *Lamachus lophyri*, Ashm., *Mastrus aciculatus*, Prov., *Delomerista diprionis*, Cushm., *Psychophagus omnivorus*, Wlk., and *Hemiteles* sp.; none was at all common. *Microplectron fuscipenne*, Zett., was the only introduced parasite recovered. It was present during the two years under survey at almost every point at which it had been liberated, and laboratory rearings of field-collected host cocoons indicated that it is increasing in several places. The highest recorded parasitism was 32·5 per cent. at one point in 1941. *Gilpinia hercyniae* is still abundant enough to become of importance if the larval disease should subside, but in this event, there is some prospect of checking it by means of imported parasites.

In 1941, nymphs and adults of *Podisus* spp. frequently preyed upon the larvae of the sawfly. These Pentatomids were especially abundant in the Laurentides Park, where, towards mid-summer, they killed almost as many larvae as did the disease. They were much less active in 1942.

DUNCAN (J.). **Comment combattre le thrips du glaïeul,** *Taeniothrips gladioli* **M. & S.**—*28th Rep. Quebec Soc. Prot. Plants 1936–43* pp. 44–45. [Quebec, 1944.]

In view of the continued increase in the commercial cultivation of *Gladiolus* in Quebec and the importance of the losses caused by *Taeniothrips simplex*, Morison (*gladioli*, Moult. & Stnw.), the injury due to this thrips is described and control measures summarised. The latter include, in addition to others already noticed [*R.A.E.*, A **23** 757; etc.], the adoption of crop rotation and the arrangement of successive plantings so that the prevailing wind will not carry thrips from the early to the later ones.

DUNCAN (J.) & DOYLE (A.). **Enfouissement et répression de la pyrale du maïs.**—*28th Rep. Quebec Soc. Prot. Plants 1936–43* pp. 46–47. [Quebec, 1944.]

The results are given of experiments in Quebec to determine the value of burying maize stalks and débris after harvest in controlling *Pyrausta nubilalis*, Hb. Of 750 larvae in stems buried 3–5 ins. deep in 1940 and 500 in the autumn of 1941, the numbers that remained in the stems and (in brackets) that died were 41 (20) and 64 (60), respectively; of 300 larvae buried in the spring of 1942, none remained in the stems. It therefore appears that buried larvae tend to return to the soil surface and seek another shelter. The percentages that remained in the soil when the stalks were buried in mid-September, at the end of September and at the beginning of October 1940 were 11, 44 and 93, respectively. It is concluded that late ploughing is not of first importance against *P. nubilalis*, but that it has some value.

KEENAN (W. N.). **The Japanese Beetle in Canada.**—*28th Rep. Quebec Soc. Prot. Plants 1936–43* pp. 48–49. [Quebec, 1944.]

An outline is given of the precautions adopted in Canada to prevent the entry of *Popillia japonica*, Newm., from the eastern United States, its occurrence and the measures applied against it in southern Ontario in 1940–42, and the results of the trapping campaign in 1942 [*cf. R.A.E.*, A **33** 137].

RYAN (W. St.-G.). **The Inspection of Grain Elevators during Wartime.**—*28th Rep. Quebec Soc. Prot. Plants 1936–43* pp. 50–52. [Quebec, 1944.]

Grain for export is not usually stored for any length of time in Canada and insect pests are accordingly of little importance, but, under war-time conditions, it has had to be kept in elevators in Montreal, and these have been inspected

periodically since 1940. This short report of the findings includes notes on the method of unloading grain into the bins and transferring it from them into ships, and lists of the insects found in the bins and in other parts of the elevator ; these mostly comprise the species usually associated with stored grain. In general, the elevators and machinery were found to be very free from infestation. The floors were being swept constantly on account of the large accumulation of dust caused by the friction of the grain when it was being unloaded, reloaded or transferred from one bin to another. Most insects were found in the sides of the bins about 3 ft. above the surface of the grain, where there was a large accumulation of dust ; below the surface the walls were cleaned by the friction of the grain when the bins were emptied. In order to remove the dust, etc., from the tops of the bins, the grain was levelled and covered with tarpaulins, after which the walls were brushed and scraped ; the dust and débris were then lifted out, and the ceiling and sides further cleaned by means of compressed air. As the part of the bin where insects are most abundant would be covered by the grain when it was levelled, it was recommended that the grain should first be lowered four feet. It should be levelled as soon as possible after the bins have been filled.

During the inspections in 1940–43, the condition of the grain was in general good, but in 1943 the surface in some bins was completely webbed over by *Plodia interpunctella*, Hb., or crusted to a depth of 2 ins. by *Tinea granella*, L. In such cases, the infested grain was removed and, where possible, the remainder transferred to other bins, a process that usually kills all the mites and many of the insects present.

Bodenheimer (F. S.). **Studies on the Life-history and Ecology of Coccinellidae : I. The Life-history of** *Coccinella septempunctata* **L. in four different zoogeographical Regions (Coleoptera : Coccinellidae).**—*Bull. Soc. Fouad 1er Ent.* **27** pp. 1–28, 11 figs., 8 refs. Cairo, 1943.

From his own investigations and the published and unpublished observations of others, the author gives a detailed account of the bionomics and seasonal history of *Coccinella septempunctata*, L., in Palestine and notes on its life-history in the Euro-Siberian region, Anatolia, and Egypt and the Sinai Peninsula. The extent to which the climate of these areas favours it and the significance of its migrations to the tops of mountains during the summer are discussed. From feeding experiments in Palestine, the author concludes that the Coccinellid is of no greater importance there in the destruction of Aphids than it is in Germany [*cf. R.A.E.*, A **18** 436].

Rivnay (E.). **A Study on the Efficiency of** *Sympherobius amicus* **Navás in controlling** *Pseudococcus citri* **Risso on** *Citrus* **in Palestine (Neuroptera-Hemerobiidae and Hemiptera-Homoptera-Coccidae).**—*Bull. Soc. Fouad 1er Ent.* **27** pp. 57–77, 5 figs., 4 refs. Cairo, 1943.

Attempts have been made in Palestine to use an indigenous species of *Sympherobius* for the control of *Pseudococcus citri*, Risso, on *Citrus*. It was at first thought to be the Eritrean *S. amicus*, Navás, and though it was subsequently described as *S. sanctus* by Tjeder [who considered *S. amicus* unrecognisable], its distinctness from the latter is uncertain. Following favourable results in laboratory and preliminary field experiments [*cf. R.A.E.*, A **16** 630], this Hemerobiid was bred in large numbers in the laboratory and liberated in *Citrus* groves over several years. Very little control was obtained, however, and the investigations described in this paper were therefore carried out to ascertain what factors were responsible for this. It appeared that the failure was not primarily due to difficulty in finding the mealybugs on the trees, for although *P. citri* sometimes occurs in positions that are difficult to reach, the Hemerobiid was no more successful against mealybugs of the group of

P. comstocki, Kuw. [*cf.* **29** 74 ; **32** 86], which are very accessible. It was also apparently not due to parasitism, since no parasites were reared from larvae of *Sympherobius* that were exposed in dishes in the grove.

Experiments were therefore carried out in the laboratory and the field to ascertain whether climate was responsible. The results are given in some detail and discussed. They showed that the principal adverse factors are high temperature and low humidity ; mortality was very high in larvae at 30°C. [86°F.] and in eggs and pupae at 35°C. [95°F.], and the life and fertility of adults were reduced as the temperature exceeded 30°C. During April, May and early June, when *P. citri* occurs between the sepals and the young fruit and is not easily accessible to *Sympherobius*, the temperature sometimes rises to above 40°C. [104°F.], when the khamsin wind blows, and the relative humidity may then fall to below 10 per cent. Adults liberated at this time would have difficulty in finding food and establishing themselves, and mortality of any eggs and larvae produced would be very great. During late June, July and August, in very favourable years, *P. citri* infests the fruits at the points of contact between fruits or between fruits and leaves, and climatic conditions are more favourable for *Sympherobius*. The temperature is still too high, with consequent reductions in egg-production, but if liberated then it could find food and reproduce to some extent. There are difficulties in the way of liberations at this season, however, since the production of hosts on potato sprouts for mass breeding of *Sympherobius* during the summer is not easy, and it must be released at the rate of not less than 100 per tree if any control is to be obtained. During September and October, when infestation of the fruit may be considerable, the climatic conditions are similar to those prevailing in the spring, though the khamsin wind may not be so severe, and mass breeding of *Sympherobius* is still difficult. During the winter, *P. citri* does not occur on the trees, so that no control is necessary, and *Sympherobius* hibernates in the pupal stage. In view of these results, the value of further releases of the Hemerobiid is questioned.

CASSAB (A.). **Le régime alimentaire de la courtilière (Orthoptera : Gryllotalpidae).** —*Bull. Soc. Fouad 1er Ent.* **27** pp. 83–85. Cairo, 1943.

Investigations in Egypt showed that mole-crickets (*Gryllotalpa*) feed on both animal and vegetable matter. The food of individuals reared in cages included parts of the bodies of earthworms and various insects, exuviae, the eggs of Acridids, maize, crushed rice, potato tubers, carrots and lettuce leaves, substances with a high water content being preferred ; both sexes attacked dead, weakened or undersized examples of their own genus, although other suitable food was available. Mole-crickets have also been observed to feed on the egg-pods of *Schistocerca gregaria*, Forsk., in breeding cages. Examination of the contents of the alimentary canal of individuals that had been offered food of both animal and vegetable origin indicated some preference for the former.

In observations on *G. gryllotalpa* var. *cophta*, De Haan, in which groups of 25 were kept in soil of different types with or without additional food, survival among individuals in soil rich in organic matter (Nile mud) was about the same over a period of three months whether additional food was provided or not. The numbers alive after six months, with and without supplementary food, were 22 and 18 in Nile mud, 20 and 16 in a mixture of Nile mud and ordinary soil, and 19 and 15 in ordinary soil. In manured soils, development and survival were similar with or without additional food.

HABIB (A.). **The Biology and Bionomics of** *Asterolecanium pustulans* **Ckll. (Hemiptera-Coccidae).**—*Bull. Soc. Fouad 1er Ent.* **27** pp. 87–111, 19 figs., 5 graphs, 9 refs. Cairo, 1943.

Descriptions are given of all stages of *Asterolecanium pustulans*, Ckll., of which *A. p. sambuci*, Ckll., has been found to be a synonym, together with an account

of its world distribution and of investigations on its bionomics and control in Egypt, where it infests many plants, fig being economically the most important. It occurs on the stems, shoots, leaf-stalks, mid-ribs of the leaves and sometimes the fruits, and causes green tissue to swell round it in the form of a cup. Infestation is most severe in the fig-growing areas of the Mediterranean coast, the Delta, Middle Egypt and some parts of Upper Egypt. Conditions of temperature and humidity are most favourable in the coastal areas and parts of Middle Egypt.

In laboratory experiments, the egg stage was shortest (12 days) at 31°C. [87·8°F.]; it increased to 13 days at 33°C. [91·4°F.], all eggs dying at 35°C. [95°F.], and to 87 at 13°C. [55·4°F.]; the threshold of development of the eggs was calculated to be 10°C. [50°F.]. Mortality was lowest (14·2 per cent.) at 25°C. [77°F.]. When the Coccid was reared on potted oleander (*Nerium oleander*) in 1934 under natural conditions, from May onwards, the crawler and passive nymphal stage lasted 2–6 and 10–17 days, the adults lived for 73–87 days and oviposited during the last 11–16 days of life, and the eggs hatched in 18–29 days. Females laid 66–192 eggs each, with an average of 128. Mortality among the eggs and crawlers was high. No males were obtained in collections from various plants and different parts of the country, so that reproduction is parthenogenetic. There are three overlapping generations a year, the crawlers hatching in mid-May, in early September and, after a prolonged incubation period, in late January. Natural enemies observed were *Karnyothrips flavipes*, Jones, and *Haplothrips cahirensis*, Tryb., larvae of the Noctuid, *Autoba gayneri*, Roths., and the Pteromalid parasite, *Enargopelte* sp.

Fumigation of fig and oleander trees with hydrocyanic acid gas was ineffective as the gas did not penetrate through or between the tests of the insects and the swollen tissue surrounding them. A spray of lime-sulphur prepared from quick-lime, sulphur and water (1 : 2 : 12) and found to contain 10 per cent. of dissolved free sulphur was applied to oleander at dilutions of 1–4 per cent. when the first crawlers were hatching and again after three weeks, to allow all to hatch. The best results (99·5 per cent. mortality) were given by a dilution of 3·5 per cent., which did not scorch the trees. In tests of proprietary sprays applied under the same conditions, good results were obtained with one of several mineral-oil emulsions and with two tar distillates, all at 2·5 per cent. A home-made emulsion of kerosene and soap was effective only at concentrations that injured the trees. An emulsion of light solar oil (a crude distillate) was effective at lower concentrations and was less harmful to the trees. Further tests showed that the concentration of oil could be reduced without loss of efficiency if orthodichlorbenzene or paradichlorbenzene was added to the emulsion, and the formula finally recommended is 2 gals. light solar oil, ½ lb. ortho- or paradichlorbenzene, 3 lb. fish-oil soap and 1 gal. water diluted to a concentration of 1 : 40.

Hosny (M.). **Coccidae new to Egypt, with Notes on some other Species (Hemiptera).**—*Bull. Soc. Fouad 1er Ent.* **27** pp. 113–123. Cairo, 1943.

Records are given of the food-plants and distribution in Egypt and throughout the world of seven Coccids recently found in Egypt for the first time or after an interval of some years, together with descriptions of the adult females of most and of the immature stages of some. *Ferrisia* (*Pseudococcus*) *virgata*, Ckll., was observed for the first time in September 1939 and had been found on upwards of 60 plants of 38 families by April 1942. Infestation was heavy on some of them, notably *Lantana camara*. *Pseudococcus maritimus*, Ehrh., which had previously been found on bananas in the Cairo fruit market, was first observed on growing plants in 1940. It occurred on carnations, *Camellia*, *Croton*, *Melia azedarach*, *Canna* and *Dracaena*. All the infested plants were destroyed. *Coccus* (*Lecanium*) *acuminatus*, Sign., severely damaged mango in a

garden in February 1936, the upper surface of heavily infested leaves being covered with a sooty mould ; mango trees were later found to be infested in two other gardens, and the area was placed under quarantine. Heavy infestations of *Pulvinaria psidii*, Mask., occurred in 1932 on *Ficus bengalensis* near Cairo and spread to many other plants, including *F. rubiginosa* and mango. This Coccid had been found on *F. glomerata* in 1925. *Eulecanium persicae*, F. (*berberidis*, Schr.) was found on a mulberry tree, from which it soon disappeared, in 1925, and on grape-vines in April 1933. The infestation of the vines was moderately severe, but local, and was apparently eradicated by pruning and spraying in February 1934. *Aulacaspis cinnamomi*, Newst. (*A. c. mangiferae*, Newst.) infested mango in one garden in 1916 and in another garden later, The trees in the first garden were destroyed and those in and near the second were kept under observation. In 1940, however, the Coccid was reported in six neighbouring mango groves and the area was placed under quarantine. *A. cinnamomi* is heavily attacked by Hymenopterous parasites, of which the most important are the Aphelinids, *Prospaltella berlesei*, How., and *Aphytis diaspidis*, How. *Parlatoria ziziphus*, Lucas, was recorded in 1937 on *Citrus*, notably mandarin oranges, in Alexandria, where infestation was in some cases very heavy, and in isolated gardens near Cairo. The movement of uncertified plants from Alexandria was prohibited.

The results of tests with various proprietary oil emulsions against *C. acuminatus*, *E. persicae*, *A. cinnamomi* and *P. ziziphus*, and of tar distillates and lime-sulphur against *C. acuminatus* are given in tables. High rates of mortality of each species were obtained with one or more of the oil sprays. Lime-sulphur was not highly effective against *C. acuminatus* but the tar distillates and one of the mineral oils gave 100 per cent. mortality of this species.

HUSSEIN (M.). **A short Account on the Propagation and Control of the Desert Locust, *Schistocerca gregaria* Forskål, in some Parts of Arabia (Orthoptera).**—*Bull. Soc. Fouad 1er Ent.* **27** pp. 159–173, 4 figs., 1 map. Cairo, 1943.

The movements of swarms and breeding of *Schistocerca gregaria*, Forsk., in five areas in the coastal plains of Asir and Hedjaz and in north-eastern Arabia from December 1942 to June 1943 are summarised, and notes are given on its abundance, the stages and phases observed, climatic conditions, vegetation, and the control measures (chiefly the application of poison baits) adopted in each of the areas.

Vorratsschädlinge. [Pests of Stored Products.]—*Verh. 7. int. Kongr. Ent., Berlin 1938* **4** pp. 2747–2926. Weimar, 1939.

The papers in this section include : **Die Hausbockkäferfrage im Jahre 1938** [The Question of *Hylotrupes bajulus*, L. (infesting timber in buildings) in Germany in 1938], pp. 2766–2809, by [A.] FRANZKE [*R.A.E.*, A **27** 204] ; **Die technische Prüfung der Hausbockkäfer-Bekämpfungsmittel** [The technical Testing of Preparations for controlling *Hylotrupes bajulus*, L.], pp. 2872–2881, 3 figs., 1 pl., 3 refs., by B. SCHULZE [**27** 203] ; and **Recherches sur la teneur en eau du charançon du riz** (*Calandra oryzae*) **et la possibilité d'emploi de poudres deshydratantes pour abaisser cette teneur à un taux mortel,** pp. 2840–2841, 2 refs., in which F. LEPESME describes experiments on the dehydration of *Calandra oryzae*, L., by magnesium oxide [*cf.* **27** 585].

In **Stand der Kornkäferbekämpfung in bäuerlichen Betrieben und dergleichen** [The Position with Regard to Control of the Grain Weevil on Peasant Farms and in similar Places], pp. 2749–2752, K. T. ANDERSEN gives brief notes on the bionomics of *Calandra granaria*, L. [*cf.* **22** 719], pointing out that it may be expected to produce three generations a year in unheated granaries in Germany and five in heated ones, and reviews methods of preventing or controlling

infestation of grain in store-rooms that cannot be fumigated by ordinary methods because they are not air-tight. These include thorough cleaning of the granaries before the grain is deposited in them; keeping them well ventilated and cool; frequent turning of the grain with a shovel to check heating and disturb the weevils, which should be collected from the surface of the heap and burnt; heating sacks in ovens at 50–60°C. [122–140°F.]; and spraying empty granaries. Grain can be fumigated with hydrogen phosphide by the Delicia method [*cf.* **33** 230], even in premises that are not air-tight, though weevils on the walls and floors will survive unless they are.

The information on methallyl chloride contained in **Neue Gase zur Bekämpfung von Vorratsschädlingen und die Feststellung ihres praktischen Wertes** [New Gases for the control of Pests of Stored Products and the Determination of their practical Value], pp. 2753–2765, 1 graph, by C. J. BRIEJÈR, has been noticed from a more detailed source [**28** 76–78]. The author further states that in laboratory experiments, complete mortality of adults of *Calandra granaria* was given by fumigation for 24 hours at 20°C. [68°F.], with methallyl bromide at the rate of 4½ oz. per 1,000 cu. ft., the corresponding dosage for methallyl chloride being 18¾ oz. Though the bromide is more expensive and much more poisonous to higher animals, it is worth attention as a fumigant. In further work, good results were obtained with allyl bromide, though allyl chloride was inferior. Both communicated a pungent odour to the materials fumigated with them and allyl bromide is highly poisonous to higher animals and affects the eyes.

Der Hausbock, seine Schadenwirkung und seine Bekämpfung [*Hylotrupes bajulus*, its Injuriousness and Control], pp. 2810–2824, 3 pls., 1 ref., by [O.] HESPELER, contains a short account of the life-history of the Cerambycid, *Hylotrupes bajulus*, L., in structural timbers in Germany and of the threat that it constitutes in buildings [*cf.* **24** 612; **25** 499; **27** 204]. The control measures reviewed include fumigation with hydrocyanic acid gas, the hot-air process [*cf.* **21** 214], treatment of the woodwork with suitable insecticides [*cf.* **27** 202], thorough inspection of treated woodwork for living larvae for a year after their application, utilisation of the predacious Clerid, *Opilo domesticus*, Sturm, against the larvae [*cf.* **17** 463], screening windows and ventilators in roofs to prevent the entry or exit of the beetles, and the destruction of any beetles seen.

In **Oekologisch-biologische Beobachtungen an schädlichen Dermestiden** [Observations on the Ecology and Biology of injurious Dermestids], pp. 2825–2832, H. KEMPER deals chiefly with species of *Anthrenus* and *Attagenus*, which damage woollen goods, furs and feathers in Germany [*cf.* **27** 513; **28** 4]. Collections of Dermestids were made over several years in houses and outdoors, chiefly in and near Berlin, and the frequency of occurrence of the individual species is shown in a table, from which it is evident that *Anthrenus scrophulariae*, L., was the most widespread in houses, followed by *A. verbasci*, L., and *Attagenus pellio*, L., which were encountered almost equally often, whereas *A. piceus*, Ol., *Anthrenus museorum*, L., *A. pimpinellae*, F., and the four species of *Dermestes* taken were rare. Outdoors, only *Anthrenus* spp., notably *A. verbasci*, were common on flowers, while *A. pimpinellae* was the Dermestid most frequently taken in birds' nests. The beetles were found throughout the year in houses, and so presumably developed continuously there, whereas they were present on flowers only from early May to early August. This and the differences in the respective frequency of the individual species in houses and outdoors suggest that outbreaks of *Anthrenus* in houses are much less often due to infestation from without than is commonly believed, and that the species concerned, or at any rate the economically most important *A. scrophulariae*, are represented by two ecologically distinct varieties, of which one breeds indoors and does not visit flowers, whereas the other breeds in the open. This view was supported by constant differences in coloration of the adults of *A. scrophulariae* taken on flowers and in dwellings in the same locality in the summer of 1935, and by

experiments in which house strains of *A. scrophulariae* and *A. verbasci* could be easily reared in the laboratory at any time of the year, while field strains could not. Eggs of both species laid by beetles taken on flowers gave rise to adults in autumn when reared in the laboratory, but these failed to emerge from the larval skin [*cf.* **27** 47] and died, whereas when the pupae of *A. verbasci* were exposed to cold, they overwintered and did not give rise to adults until the spring. Some eggs were obtained from the latter. It thus appears that a diapause is obligatory in field strains of *Anthrenus* spp. and not in house strains.

In **Beiträge zur Kenntnis der Gattung** *Anthrenus* **(Coleoptera-Dermestidae)** [Contributions to Knowledge of the Genus *Anthrenus*], pp. 2833–2839, 7 pls., G. KUNIKE discusses the characters differentiating the adults, larvae, pupae and the last larval skin (in which pupation takes place) of *Anthrenus scrophulariae*, L., *A. verbasci*, L., *A. pimpinellae*, F., *A. museorum*, L., and *A. fuscus*, Ol., the five species of the genus native to Germany. The larvae of the last three occur chiefly in birds' nests and dovecots, whereas those of *A. scrophulariae* and *A. verbasci*, the life-histories of which are briefly reviewed [*cf.* **28** 4–6], develop in houses and are important pests of stored products.

In **Contribution à l'étude systématique et biologique des dermestes nuisibles (Coleoptera, Dermestidae),** pp. 2842–2855, 26 figs., 1 ref., P. LEPESME gives keys to the adults of the ten species of *Dermestes* that are economically the most important and to the larvae of eight of them, brief descriptions of the adults of each species, with notes on synonymy [some of which he has since modified (*cf.* **28** 389)] and general descriptions of the immature stages of *Dermestes* spp. The world distribution of the ten species is briefly discussed, and notes are given on their bionomics and the damage that they cause to many products of animal and vegetable origin and occasionally to wood and metals, particularly lead. It is considered, however, that they cannot develop normally on vegetable matter alone.

In **Drogenschädlinge** [Pests of Drugs], pp. 2856–2862, 1 pl., by W. MADEL, a brief account is given of the infestation of various drugs in Germany by insects that are not generally associated with these products. They comprise larvae of *Tineola biselliella*, Humm., and *Trogoderma granarium*, Everts, which developed in preparations containing albumen, the latter being sometimes associated in powders with *Anthrenus verbasci*, L. ; and larvae of *Plodia interpunctella*, Hb., *Ephestia elutella*, Hb., *Attagenus pellio*, L., and *A. piceus*, Ol., and larvae and adults of *Ptinus tectus*, Boield., all of which occurred in drugs of vegetable origin. Lists are also given of drugs and other products infested by *Sitodrepa panicea*, L., and of the plants that it was observed to injure in herbaria [**19** 303], and it is stated that *Lasioderma serricorne*, F., is frequently imported into Germany in drugs, tobacco, etc. [*cf.* **27** 521].

In **Die Kornkäferbekämpfung auf Getreideböden und auf Getreidekähnen** [Control of the Grain Weevil in Granaries and on Barges conveying Grain], pp. 2863–2866, 2 pls., MISCHON describes the Delicia process of fumigating grain against *Calandra granaria*, L., with hydrogen phosphide, generated from a preparation of phosphides by contact with the moisture in the grain. The preparation is contained in permeable bags, which are themselves placed in larger protective bags and inserted into the grain to a depth of 8–12 ins. The grain is then covered with specially prepared paper to delay the escape of the gas and left for eight days, after which decomposition of the phosphides is complete and the grain can be uncovered. The used bags should be buried or burnt. The method has also proved effective against other insect pests of stored grain, as well as rats and mice, and it does not impair the germinating power or other properties of the grain or affect the flour made from it. It can be successfully applied in large granaries and on barges, and, as no sealing is necessary, it is particularly suitable for use in farm granaries that are not gas-proof. Since the gas is generated slowly, the concentration in the air is always

low and there is little danger to operators unless it is inhaled for long periods [but *cf.* **25** 386].

In **Die Einwirkung oberflächenaktiver Stoffe auf Insekten** [The Effect on Insects of Surface-active Substances], pp. 2884–2891, F. ZACHER reviews his earlier work on the use of inert dusts against insect pests of stored products [**17** 641 ; **18** 664 ; **26** 252], the lethal action of which he ascribes to dehydration by adsorption, and gives the results of further laboratory experiments in which complete mortality of adults of the grain weevil [*Calandra granaria*, L.] at 12–19·5°C. [53·6–67·1°F.] and 52–67 per cent. relative humidity was given in 2–4 days by treatment with various dusts of activated carbon and in 4–5 days by a proprietary silicic-acid dust (Naaki). Bran dust was ineffective. Burying one-day-old eggs of the flour moth [*Ephestia kuehniella*, Zell.] in Naaki for 2–8 days did not reduce hatching, but only two larvae of the 95 that hatched from the eggs buried for 8 days survived. All migrating larvae of *Plodia interpunctella*, Hb., treated with Naaki, activated carbon and a dust of pyrethrum and derris were dead in 8, 2 and 2 days, respectively, whereas a dust of derris alone killed only 30 per cent. in 10 days. Field experiments with both Naaki and a pyrethrum-derris dust against flea-beetles were inconclusive, but in the laboratory hop flea-beetles [*Psylliodes attenuata*, Koch] treated with Naaki were all killed in 4 days, whether or not hop leaves were provided after dusting. The elm leaf beetle, *Agelastica alni*, L., and especially the ant, *Paratrechina* (*Prenolepis*) *longicornis*, Latr., proved very susceptible; the latter succumbed in 15 hours in the laboratory and promising results were also obtained against it in the field.

In **Die Dörrobstmotte und die Kakaomotte** [The Dried Fruit Moth and the Cacao Moth], pp. 2892–2902, F. ZACHER gives an account of the bionomics of *Plodia interpunctella*, Hb., based on his own observations in Germany [*cf.* **28** 42] and those of others. He now states that not more than two generations are to be expected annually in unheated storehouses in Germany, the larvae of the second resting in their cocoons throughout the winter [*cf.* **26** 460]. The duration of development depends not only on the nutritive quality of the food, but also on its hardness ; at 18–20°C. [64·4–68°F.] complete development on walnut, coarsely ground chicory and raisins lasted 70, 122 and 155 days, respectively [*cf.* **24** 130], and the rate of mortality on chicory was very high. Since feeding by the adult females on sugar solution markedly increases their reproductive capacity [**28** 42], it is important to prevent the condensation of water in confectionery factories, where sugar present on the walls and in cracks in the floor may be dissolved in the water. The outer walls of storerooms should therefore be double, and good ventilation provided. Storehouses should be kept cool, as mass breeding of the moth ceases at 15–16°C. [59–60·8°F.], and, to avoid sudden increases in temperature, the roof should be well insulated.

Experiments on control were made with sprays [**28** 43] and dusts. Of larvae shaken up daily with a silicic-acid dust (Naaki) 60 and 100 per cent. died in 4 and 9 days, respectively, and activated carbon killed them all in one day. A dust of pyrethrum and derris gave complete mortality in four days, whereas derris powder alone killed only 20 per cent. in 10 days. Fumigation with sulphur dioxide obtained by burning sulphur killed the larvae in the laboratory, but was not effective in practice, probably owing to its insufficient penetrative power ; fumigation with T-gas or Cartox [mixtures of ethylene oxide and carbon dioxide] or with hydrocyanic acid gas is therefore recommended.

The importance of avoiding confusion between the cacao moth (*Ephestia elutella*, Hb.) and the date moth (*E. cautella*, Wlk.) is emphasised; the former is established in Germany and is sometimes abundant in buildings containing hay, whereas *E. cautella* is imported from countries in which cacao is grown and requires higher temperatures for development. The author concludes from his observations that the economic importance of *E. elutella* has been overrated

[*cf.* **23** 286], and that many instances of damage ascribed to it are due to other species, including the flour moth [*E. kuehniella*, Zell.] and *Myelois ceratoniae*, Zell., or to mixed infestations.

Die wirtschaftliche Bedeutung und wissenschaftliche Entwicklung des Vorratsschutzes [The economic Importance and scientific Development of the Protection of Stored Products], pp. 2903–2912, by F. ZACHER, is a survey of the more important insects that infest stored products of various kinds, including grain, flour and foodstuffs, tobacco, constructional timbers and textiles with special reference to Germany, and of the losses caused by them in that country and elsewhere. Investigations carried out in the present century on the biology and control of such pests are very briefly reviewed, and it is concluded that much progress has been achieved during the last 20 years in methods of safeguarding stored materials from infestation.

In **Die Gliedertierfauna der Mühlen und Getreidespeicher** [The Arthropod Fauna of Mills and Grain Warehouses], pp. 2913–2918, F. ZACHER compares lists of insects and mites recorded from flour mills and granaries in Germany [**27** 8] and from warehouses [**18** 502] and railway premises [**26** 165] in England, reproducing data from all three lists. He points out that storehouse conditions differ considerably from those obtaining in the field or in human dwellings, so that the Arthropod fauna in warehouses has a character of its own, and briefly reviews the different biological groups involved. In conclusion, he gives a list of 14 insects and two mites recorded for the first time in storehouses in Germany.

In **Verschleppung und Einbürgerung von Vorratsschädlingen** [The Introduction and Establishment of Pests of stored Products], pp. 2919–2926, F. ZACHER states that 170 insects and mites that are pests of some importance have been found in storehouses, factories and houses in Germany. About 100 of them are indigenous, and 20 introduced ones have become established. Lists are given of the most important species, with notes on the distribution, economic importance and habitat of some 40 imported ones. Stored-product pests are continually being introduced in ships, and care is needed to ensure that new ones do not become established.

PETCH (T.). **Notes on Entomogenous Fungi.**—*Trans. Brit. Mycol. Soc.* **27** pts. 1 & 2, pp. 81–93. London, 1944.

Among the seven new species of entomogenous fungi described are *Entomophthora anglica*, which was collected from several Coleoptera in Britain, including *Agriotes sputator*, L., and the heather-beetle, *Lochmaea suturalis*, Thoms., *Cylindrodendrum suffultum* from Tipulid pupae in Norfolk, and *Verticillium larvarum*, from a nettle-grub [Limacodid larva] in Ceylon. Other species discussed include *Empusa forficulae* var. *major* from earwigs [*Forficula auricularia*, L.] in Norfolk, *Entomophthora coleopterorum* from *Sitona flavescens*, Marsh., in Ireland, *E. virescens*, which was collected from a single larva during an outbreak of cabbage caterpillars in England in 1942, and *Uredinella spinulosa* from *Aspidiotus* sp. in Ceylon.

The Importation of Plants (Amendment) Order of 1945.—*S.R.O.* 1945, no. 583, 1 p. London, 1945.

This Order, which came into force on 5th June 1945, imposes on the importation into England and Wales of plants, potatoes, raw vegetables and cider apples grown in Portugal, where the Colorado beetle [*Leptinotarsa decemlineata*, Say] has become established, the restrictions already applied to them when grown in other countries where the beetle is present [*R.A.E.*, A **27** 356; **28** 297].